JULY 1, 2026

PROJECT MANUAL

NCWSA OFFICE ADDITION: 100% DESIGN - CONSTRUCTION DOCUMENTS

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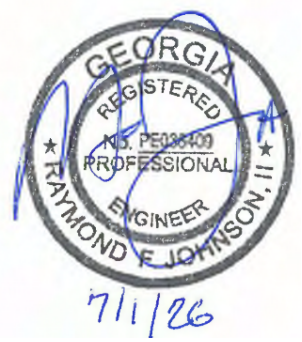
NEWTON COUNTY WATER AND SEWAGE AUTHORITY

NCWSA Office
11325 Brown Bridge Road
Covington, Georgia 30016

Wendel Project No 616202



6/30/26



7/1/26



7/1/2026





06/30/2026



7/1/26

wendel

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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. Project Information

B. Work Covered by Contract Documents

C. Work under separate contracts

D. Access to site

E. Coordination with occupants

F. Contractor use of premesis

G. Work restrictions

H. Specification and drawing conventions

1.3 PROJECT INFORMATION

A. Project Identification: NCWSA Office Addition
   1. Project Location: 11325 Brown Bridge Road, Project Location Address 2, Covington, Georgia30016

B. Owner: Newton County Water & Sewer Authority

C. Architect: Wendel Architecture, P.C., 1100 Abernathy Road, NE, Suite 1050, Atlanta, GA 30328.

D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents.
   1. Civil - Brown & Caldwell.
   2. Structural - PES Engineers.
   3. Mechanical - Wendel.
   4. Electrical - Wendel.
   5. Plumbing - Wendel.
   6. Fire Protection - Wendel.

E. Construction Manager: Construction Manager Name
   1. Construction Manager has been engaged for this Project to serve as an advisor to the Owner and to provide assistance in administering the Contract for Construction between

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the Owner and each Contractor, according to a separate contract between Owner and Construction Manager.

2. Construction Manager for the Project is the Project's Constructor. The terms "Construction Manager" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
Addition to and partial renovation of the NCWSA Adminstration Building

1.5 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 and will assign to separate contractor(s) separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
1. Audio/Visual.
2. Security.
3. Low-Voltage.

1.6 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. 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. Limits: Confine construction operations to __.
2. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
3. Driveways, Walkways and Entrances: Keep driveways parking garage and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

D. Deliveries shall be coordinated with the Construction Manager.

E. Schedule deliveries to minimize use of driveways and entrances by construction operations

F. Schedule deliveries to minimize space and time requirements for storage construction operations.

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G. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Provide not less than 48 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

C. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
   1. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
   2. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
   3. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. Owner Occupancy: Allow for Owner occupancy and use by the public for the entire duration of the project. Owner's operations are continuous, 24 hours per day, 7 days per week, 365 days per year.
   2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
   3. Owner's existing parking lots are not to be used for parking of construction workers vehicles or staging of materials or equipment, unless authorized specifically by the Owner.

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4. All deliveries to the Contractor at the site must be accepted at the site by the Contractor, regardless of time of delivery. The Owner will not accept deliveries for the Contractor at any time.

B. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair any damage caused by weather or construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. Restore to new condition any lawn, pavement, sidewalk, etc., damage by construction and staging operations.
1. Repair lawns with sod matching existing lawns, not with seed.

1.9 WORK RESTRICTIONS

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

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 3:30 p.m., Monday through Friday, unless otherwise indicated.
Weekend Hours: To Be Determined by Owner
Early Morning Hours: To Be Determined by Owner
Hours for Utility Shutdowns: To Be Determined by Owner

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
Notify Owner's Representative not less than seven (7) days in advance of proposed utility interruptions.
Obtain Owner's Representative written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
Notify Owner's Representative not less than seven (7) days in advance of proposed disruptive operations.
Obtain Owner's Representative written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building and the Project site at any time. There will be no exceptions.

F. Controlled Substances: Use of tobacco products and other controlled substances within the building is not permitted.

G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

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

1.10 SPECIFICATION AND DRAWING CONVENTIONS

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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.

B. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents are abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
   3. The words "Shall", "Shall Be" or "Shall Comply With," depending on the context, are implied where a colon (:) is used within a sentenace or phrase.
   4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

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

1.11 MISCELLANEOUS PROVISIONS

A. Project Superintendent: The Owner must approve the Contractor’s project superintendent for the work. Submit resume of proposed superintendent together with Bid.
   Full Time Superintendent: The Contractor’s project superintendent is required to be on site full time for the duration of the project or until such time as mutually agreed upon by the Owner, Architect, and Contractor. No substitution of project superintendents by the Contractor after work begins will be allowed without prior approval by Architect, Construction Manager, and Owner.

B. Licensed Contractors/Subcontractors: Prime Contractor and all Subcontractors must be licensed to work in each of their perspective fields of work on the Project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

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SECTION 012100 - ALLOWANCES

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 governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor by the Architect. Additional requirements will be issued by Change Order, if any, by theArchitect.

B. Types of allowances include the following:
   1. Lump-sum allowances.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, inform Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At theArchitect 's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

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1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work.Furnish templates as required to coordinate installation.

1.7 LUMP-SUM, UNIT-COST, AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by the Architect under allowance and shall include taxes and freight and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected byArchitect under allowance shall be included as part of the Contract Sum and not as part of the allowance.

1.8 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor’s overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.9 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.10 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, submit a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

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1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measurement or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. _____: LUMP-SUM Allowance: Include the sum of _____: Include as specified in Section " _____ " and as shown on Drawings.
1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit .
2. Coordinate quantity allowance adjustment with corresponding unit-price requirements in Section 012200 "Unit Prices."

END OF SECTION 012100

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SECTION 012200 - UNIT PRICES

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 unit prices.

1.3 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid or Proposal Form, incorporated in the Agreement and applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

B. Bidders are advised that quantity allowances of work, if specified in the Contract Documents, are approximate only and are subject to increase or decrease, and that the work shall be performed at the Unit Prices stated on the Bid or Proposal Form whether the quantities are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary and incidental material, plus cost for delivery, installation, rental, insurance, applicable taxes, overhead, and profit and similar costs.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right question or to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by the Owner’s designated representative.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SCHEDULE OF UNIT PRICES

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END OF SECTION 012200

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SECTION 012300 - ALTERNATES

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 alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if accepted in writing by the Owner and enumerated in the Agreement, or added to the Agreement by Change Order.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SCHEDULE OF ALTERNATES

END OF SECTION 012300

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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.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue through Construction Managar 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 14 calendar 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.
   3. Include costs of labor and supervision directly attributable to the change.
   4. 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.
   5. 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 .
   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.

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

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. 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 012900 - PAYMENT 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 necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
   2. Submit the schedule of values to Architect at earliest possible date, but no later than five (5) calendar days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number(s).
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.

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f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
1) Labor.
2) Materials.
3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five (5) percent of the Contract Sum.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored but not yet installed.
a. Differentiate between items stored on-site and items stored off-site. Regardless of on- or off-site storage, provide evidence of insurance for such.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the 20th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month .
1. Submit draft copy of Application for Payment seven (7) calendar days prior to due date for review by Architect.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

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

F. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours.

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

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of values.
   3. Contractor's construction schedule (preliminary if not final).
   4. Products list (preliminary if not final).
   5. Schedule of unit prices.
   6. Submittal schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Initial progress report.
   11. Report of preconstruction conference.
   12. Certificates of insurance and insurance policies.
   13. Performance and payment bonds.
   14. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

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1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 012900

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PARTIAL RELEASE AND WAIVER OF MECHANIC'S LIEN

PROJECT NAME:

PROJECT ADDRESS:

OWNER:

CONTRACTOR/SUPPLIER:

CONTRACTOR/SUPPLIER'S CONTRACT NUMBER:

THROUGH PERIOD ENDING:

PARTIAL PAYMENT AMOUNT:

CONTRACTOR/SUPPLIER has provided labor, materials, rentals and/or services (collectively, "Work") on the above-described Project.

CONTRACTOR/SUPPLIER, for and in consideration of Partial Payment Amount to be paid upon execution of this Partial Release, does for itself, its successors, administrations and assigns, hereby affirm and agree as follows with respect to all Work performed to date and for which payment has been made pursuant to this Partial Release, except as noted below in Paragraph 3:

1. All labor employed in connection with the Work and the Project and all related payroll taxes and charges (such as withholding taxes, social security taxes and worker's compensation, disability and unemployment taxes and/or insurance premiums) have been paid in full; and

2. All materials, tools, equipment, supplies and services furnished and used upon or in connection with the Work and the Project have been paid for in full; and all sales, use, excise and similar taxes on or in connection with the same have been fully paid; and

3. Upon receipt by CONTRACTOR/SUPPLIER of a check from OWNER in the Partial Payment Amount described above, payable to the CONTRACTOR/SUPPLIER, and when the check has been paid, this document shall become effective to release and forever discharge the OWNER and their respective officers, directors, agents, servants and employees, and all lands, improvements, chattels, and other real and personal property connected with or a part of the Project from any and all claims, demands, liens and claims of lien whatsoever, which it now has or hereafter might or could have arising out of the performance of all Work for which payment has been made.

CONTRACTOR/SUPPLIER will, at its sole cost and expense, forever hold harmless OWNER from any and all claims and demands and will defend against and obtain the discharge of any liens and claims of lien of others arising out of or in connection with the work, including, without limitation, those claimed or asserted by any employee, supplier or subcontractor of the CONTRACTOR/SUPPLIER (or any employee or supplier of any subcontractor/supplier of the undersigned), governmental agency or any insurance carrier; and

CONTRACTOR/SUPPLIER warrants that the amount of payments received or to be received represents the total value earned by CONTRACTOR/SUPPLIER for materials, labor, rentals, equipment and services supplied to the Project for the period indicated above, for the above-described contract.

CONTRACTOR/SUPPLIER warrants that it has not and will not assign any claims for payment or right to perfect a lien against such land and improvements and appurtenances and warrants that it has the right to execute this waiver and release.

This release and waiver may not be changed orally.

CONTRACTOR/SUPPLIER agrees that the OWNER of the Project, any lender, and any title insurer may rely upon this waiver and release.

IN WITNESS WHEREOF, , of
has hereunto set her/his hand this day of _____, 20__.

CONTRACTOR/SUPPLIER:
AUTHORIZED AGENT:
WITNESS: _____ SIGNATURE:
TITLE:

STATE OF GEORGIA)
) SS.:
COUNTY OF _____)

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On the ____ day of _____ in the year 20___ before me, the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Notary Public

(Signature and office of individual taking acknowledgment.)

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FINAL RELEASE AND WAIVER OF MECHANIC'S LIEN

PROJECT NAME:

PROJECT ADDRESS:

OWNER:

CONTRACTOR/SUPPLIER:

CONTRACTOR/SUPPLIER'S CONTRACT NUMBER:

THROUGH PERIOD ENDING:

PARTIAL PAYMENT AMOUNT:

CONTRACTOR/SUPPLIER has provided labor, materials, rentals and/or services (collectively, "Work") on the above-described Project.

CONTRACTOR/SUPPLIER, for and in consideration of Payment Amount to be paid upon execution of this Final Release, does for itself, its successors, administrations and assigns, hereby affirm and agree as follows with respect to all Work performed to date and for which payment has been made pursuant to this Final Release, except as noted below in Paragraph 3:

1. All labor employed in connection with the Work and the Project and all related payroll taxes and charges (such as withholding taxes, social security taxes and worker's compensation, disability and unemployment taxes and/or insurance premiums) have been paid in full; and

2. All materials, tools, equipment, supplies and services furnished and used upon or in connection with the Work and the Project have been paid for in full; and all sales, use, excise and similar taxes on or in connection with the same have been fully paid; and

3. Upon receipt by CONTRACTOR/SUPPLIER of a check from the OWNER in the Payment Amount described above, payable to the CONTRACTOR/SUPPLIER, and when the check has been paid, this document shall become effective to release and forever discharge the OWNER and their respective officers, directors, agents, servants and employees, and all lands, improvements, chattels, and other real and personal property connected with or a part of the Project from any and all claims, demands, liens and claims of lien whatsoever, which it now has or hereafter might or could have arising out of the performance of all Work for which payment has been made.

CONTRACTOR/SUPPLIER will, at its sole cost and expense, forever hold harmless, OWNER from any and all claims and demands and will defend against and obtain the discharge of any liens and claims of lien of others arising out of or in connection with the work, including, without limitation, those claimed or asserted by any employee, supplier or subcontractor of the CONTRACTOR/SUPPLIER (or any employee or supplier of any subcontractor/supplier of the undersigned), governmental agency or any insurance carrier; and

CONTRACTOR/SUPPLIER warrants that the amount of payments received or to be received represents the total value earned by CONTRACTOR/SUPPLIER for materials, labor, rentals, equipment and services supplied to the Project for the above-described contract.

CONTRACTOR/SUPPLIER warrants that it has not and will not assign any claims for payment or right to perfect a lien against such land and improvements and appurtenances and warrants that it has the right to execute this waiver and release.

This release and waiver may not be changed orally.

CONTRACTOR/SUPPLIER agrees that the OWNER of the Project, any lender, any title insurer may rely upon this waiver and release.

IN WITNESS WHEREOF, , of
has hereunto set her/his hand this day of _____, 20___.

CONTRACTOR/SUPPLIER:
AUTHORIZED AGENT:
WITNESS: _____ SIGNATURE:
TITLE:

STATE OF GEORGIA)
) SS.:
COUNTY OF _____)

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On the ____ day of _____ in the year 20___ before me, the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Notary Public

(Signature and office of individual taking acknowledgment.)

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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.

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

1.3 DEFINITIONS

A. RFI: Request from Owner, Construction Manager, 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. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 7 calendar days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

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A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

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

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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

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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 subframing 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 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. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. 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

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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.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: DWG, Version AutoCAD, operating in Microsoft Windows operating system.
   2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
   3. 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 AutoCAD 2013 operating in Microsoft Windows.
      c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.
      d. The signed Agreement and handling and administration fee for the full set of CAD files must be received by the Architect before digital data drawings are furnished to the Contractor.

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.
   3. Architect will not review RFI’s submitted via fax or verbal requests.

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.

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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: Form immediately following this section.
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 five business days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following business 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 business days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
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 within Architect five business 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: Where indicated, the Contractor shall schedule and conduct meetings and conferences at Project site unless otherwise indicated.

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1. Attendees: Contractor shall 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: Contractor shall prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Contractor shall be responsible for conducting meeting and will record significant discussions and agreements achieved. Contractor shall distribute the meeting minutes to everyone concerned, including Owner, Contractor, and Architect within three business days of the meeting.

B. Preconstruction Conference: Contractor Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 business days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Contractor; 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 and existing building.
    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.

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C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction. Preinstallation conferences shall include conferences identified in individual Specification Sections.

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, Contractor and Owner's Representative, of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular 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. Review of mockups.
    i. Possible conflicts.
    j. Compatibility requirements.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written instructions.
    n. Warranty requirements.
    o. Compatibility of materials.
    p. Acceptability of substrates.
    q. Temporary facilities and controls.
    r. Space and access limitations.
    s. Regulations of authorities having jurisdiction.
    t. Testing and inspecting requirements.
    u. Installation procedures.
    v. Coordination with other work.
    w. Required performance results.
    x. Protection of adjacent work.
    y. 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 shall schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 calendar days prior to the scheduled date of Substantial Completion.

1. Contractor shall conduct the conference to review requirements and responsibilities related to Project closeout.

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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 completing LEED and or sustainable design documentation.
    e. Requirements for preparing operations and maintenance data.
    f. Requirements for delivery of material samples, attic stock, and spare parts.
    g. Requirements for demonstration and training.
    h. Preparation of Contractor's punch list.
    i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    j. Submittal procedures.
    k. Coordination of separate contracts.
    l. Owner's partial occupancy requirements.
    m. Installation of Owner's furniture, fixtures, and equipment.
    n. Responsibility for removing temporary facilities and controls.
4. Minutes: Contractor shall record and distribute meeting minutes.

E. Progress Meetings: Contractor shall conduct progress meetings at biweekly intervals minimally.
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.

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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: Contractor shall 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.

F. Coordination Meetings: Contractor shall conduct Project coordination meetings at bi-weekly intervals, minimally. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
   1. Attendees: In addition to representatives of Owner, ; Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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.
      b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
      c. Review present and future needs of each contractor 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) Work hours.

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10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 013100

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REQUEST FOR INFORMATION

Contractor's Name:
Address:
City, State, Zip:
Phone:
Email:

Contractor's RFI No.:_____Date:

RFI Title:_____Job No.:

PROJECT:	NCWSA Office
PROJECT No:	616202
TO:	Wendel
	1100 Abernathy Road, Suite 1050
	AAttllaannttaa,, GGAA Williamsville, New York, 14221
ATTN:	
	name@wendelcompanies.com

QUESTION:

ANSWER:

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Note: The response to this RFI is for clarification of the contract documents. The response is NOT authorization to proceed with additional work.

Answered By:_____Date:

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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 but not limited to, the following:
   1. Preliminary construction schedule.
   2. Contractor's construction schedule.
   3. Submittal schedule.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Special 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. 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.

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

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

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time belongs to Owner.
   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.

1.4 INFORMATIONAL SUBMITTALS

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A. Format for Submittals: Submit required submittals in the following format:
   1. Working electronic copy of schedule file, where indicated.
   2. PDF electronic file.
   3. Two (2) paper copies.

B. Qualification Data for Scheduling Consultant: For consultant or in-house persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Preliminary construction schedule.
   1. Approval of startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

D. Submittals Schedule: Submit submittals schedule, conforming to dates on the Contractor's Construction Schedule. Include any required submittals not included on the schedule. Arrange the following information in a tabular format:
   1. Scheduled dates for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational)
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Architect's and Owner's final release or approval.

E. Contractor's Construction Schedule: Submit on 11"x17" paper for review as required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

F. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
      a. Daily Construction Reports: Submit at weekly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

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

J. Two Week Look-Ahead Schedules: Submit at weekly intervals.

1.5 QUALITY ASSURANCE

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A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request. This shall be a consultant to the contractor or an in-house scheduling specialist, if approved by Owner.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination" and Section Section 011000 "Summary Single Prime". Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy .
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

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

PART 2 PRODUCTS

2.1 SUBMITTAL SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required per construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor’s Construction Schedule.
2. Initial Submittal: Submit within 10 business days of Notice to Proceed. Include submittals required during the first 60 calendar days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

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3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule. Update monthly as required.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

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

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Include the following:
   1. Activity Duration
   2. Procurement Activities
   3. Submittal Review Time
   4. Startup and Testing Time
   5. Commissioning
   6. Substantial Completion
   7. Punch List and Final Completion

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Products Ordered in Ad vance: Include a separate activity for each product. Include delivery date as provided or as indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date as provided or as indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   6. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
   7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.

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g. Deliveries.
h. Installation.
i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.
n. Commissioning

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.
   g. Final Completion.
9. Other Constraints: .

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

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

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

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within calendar days of date established for Notice to Proceed .

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

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

B. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 calendar days after date established for Notice of Award .

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a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Startup Testing and commissioning .
   j. Punch list and final completion.
   k. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path.
   a. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
   b. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
5. Contractor or subcontractor and the Work or activity.
6. Description of activity.
7. Main events of activity.
8. Immediate preceding and succeeding activities.
9. Early and late start dates.
10. Early and late finish dates.
11. Activity duration in workdays.
12. Total float or slack time.

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

2.5 REPORTS

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

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

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

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2.6 SPECIAL REPORTS

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

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

C. Two Week Look-Ahead Schedules: Contractor will submit a 2 week look-ahead schedule each week on a specific day of the week to be determined at the Preconstruction meeting. Each schedule will show specific work activities over that 2 week period and also areas of coordination required with other contractors and involved entities. These schedules will also show delivery dates of critical material or equipment items.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

PART 3 EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

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

C. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Owner 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

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SECTION 013233 - PHOTOGRAPHIC 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 the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final completion construction photographs.

1.3 INFORMATIONAL SUBMITTALS

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

B. Digital Photographs: Submit image files within three business days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Construction Manager .
      d. Name of Contractor.
      e. Date photograph was taken.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      g. Unique sequential identifier keyed to accompanying key plan.

PART 2 PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 EXECUTION

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3.1 CONSTRUCTION PHOTOGRAPHS

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

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

C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Construction Manager .
   1. Flag excavation areas and construction limits before taking construction photographs.
   2. Take minimum 20 photographs to show existing conditions adjacent to property before starting the Work.
   3. Take minimum 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
   4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take minimum 20 photographs weekly, as required to document construction progress, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Construction Manager will inform photographer of desired vantage points.

F. Additional Photographs: Construction Manager may request photographs in addition to periodic photographs specified..
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.
   3. Circumstances that could require additional photographs include, but are not limited to, the following:
      a. Immediate follow-up when on-site events result in construction damage or losses.
      b. Photographs to clarify Contractor’s “Request for Information.”
      c. Photographs to be taken at fabrication locations away from Project site.
      d. Substantial Completion of a major phase or component of the Work.

END OF SECTION 013233

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wendel

Submittal Transmittal

Submittal No._____

PROJECT:_____PROJECT #: _____

OWNER:_____A/E:_____

CONTRACT # & NAME_____

CONTRACTOR:

(NAME, ADDRESS, TELEPHONE & FAX NUMBERS)

☐ NEW SUBMITTAL ☐ RESUBMITTAL Date:

This submittal is: ☐ AS SPECIFIED REMARKS:

NUMBER OF COPIES SUBMITTED: (8 maximum) _____

TYPE OF SUBMITTAL: ***(CHECK ALL THAT APPLY)***

( ) PRODUCT DATA/CATALOG CUT	( ) SAMPLE	( ) COLOR SELECTION
( ) SHOP DRAWINGS	( ) SCHEDULE	( ) WARRANTY
( ) TEST REPORT	( ) RECORD DOCUMENT	( ) PERFORMANCE DATA
( ) OPERATIONS & MAINTENANCE DATA	( ) OTHER _____	

SPEC. SECTION: _____

PARAGRAPH(S): _____

DWG. REF. NO.:_____

CONTRACTOR CERTIFICATION

CONTRACTOR CERTIFIES THAT THE INFORMATION SUBMITTED COMPLIES WITH THE CONTRACT DOCUMENT REQUIREMENTS.

By: _____

Date: _____

NOTE: Contractor shall apply an approval stamp to each copy of each submittal.

DESCRIPTION OF SUBMITTAL:_____

PRODUCT NAME:_____

MANUFACTURER:_____

ADDRESS:_____ TEL. NO.:_____

CONTRACTOR or SUBCONTRACTOR:_____ TEL. NO.:_____

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SUPPLIER:_____ TEL. NO.:_____

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.

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's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. 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 for electronic documents, licensed by Adobe Systems, used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

E. Cloud-Based Construction Management Software Application (CMSA): Any of a number of proprietary file management collaborative systems intended for internet-connected device use. The intent of these applications is to enable dispersed users access to shared documents for storage, organization, retrieval, editing, tracking, reporting or other functions, with such access usually controlled by invitation and security protocols. More than one such application type or specific programs may be used, depending on Owner preferences.
   1. Project preferred CMSA: Procore

1.4 SUBMITTAL PROCEDURES

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
   1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project Record Drawings.

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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 .
c. Contractor shall execute a data licensing agreement in the form included in Project Manual.
    1) To request electronic files, complete "Request Form for Electronic Files".
    2) Include "Processing Fee" in amount as indicated on the request form.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Architect reserve(s) 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 upon 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 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager 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 business 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 20 additional business 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 business days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor .
6. Transmittal for Sample Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review or discard submittals received from sources other than Contractor. Transmit each submittal using the transmittal form at the end of this section.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

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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 Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01) and the Section Name. Resubmittals shall include the sequential number increasing with each resubmittal (e.g., 061000.02).
   b. Do not co-mingle submittals from different Specification Sections unless specifically approved by Architect.
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 Software-generated from electronic project management software or electronic form acceptable to Owner and Architect, 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, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

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

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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[s].

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, and 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[s].

PART 2 PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

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 printed 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 written recommendations.
      b. Manufacturer's product specifications.
      c. Color charts showing full range of available colors.
      d. Manufacturer catalog cuts.
      e. Wiring diagrams showing factory-installed wiring.
      f. Printed performance curves.
      g. Operational range diagrams.
      h. Mill reports.
      i. Standard product operating and maintenance manuals.
      j. Compliance with recognized trade association standards.
      k. Compliance with recognized testing agency standards.
      l. Application of testing agency labels and seals.
      m. Notation of coordination requirements.
   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.

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: Include the following information, as applicable:
      a. Dimensions.

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b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shop work manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than sheet size used for Contract Document Drawings.
4. Number of Copies: Submit two black-line prints and one electronic file copy of each submittal. Architect will return the one print marked with action taken to the Contractor for distribution. Contractor shall make necessary copies from the returned print.

D. Samples: Prepare physical units of materials or products, including the following:
1. 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.
2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
a. Generic description of Sample.
b. Product name or name of manufacturer.
c. Sample source.
4. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operation, and similar construction characteristics.
5. Number of Samples for Initial Selection: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one submittal with options selected.

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6. Number of Samples for Verification: Submit two full sets of Samples. Architect will retain one Sample set; remainder will be returned marked with action taken to the Contractor for distribution.
   a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
7. Disposition: Contractor to maintain one set 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.

E. Submittals requiring compliance with other sections in the Project Manual.
1. Contractor's Construction Schedule.
2. Submittals Schedule.
3. Application for Payment.
4. Schedule of Values.
5. Subcontract List.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by individual Specification Sections and elsewhere in the Contract Documents.
1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies, unless they are rejected for noncompliance with the Contract Documents.
2. Certificates and Certifications: Provide a notarized 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.
3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

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

C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

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F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

I. Preconstruction Test Reports: Prepare 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.

J. Compatibility Test Reports: Prepare 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.

K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.

L. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. 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.

M. Research/Evaluation Reports: Prepare 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.

N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment.

O. Design Data: Prepare 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.

P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a

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product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

Q. Manufacturers Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

R. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

S. Material Safety Data Sheets: Keep on site and submit information directly to Owner. If submitted to Architect, Architect will not review this information but will return it with no action taken.

2.3 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 file or three (3) paper copies of certificate, signed and sealed by the responsible design professional licensed in the jurisdiction of the Project for each product, assembly or 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

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

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

3.2 ARCHITECT'S ACTION

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

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Architect’s Action:
    a. Final Unrestricted Release: When the Architect marks a submittal “No Exceptions Taken” the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
    b. Final-But-Restricted Release: When the Architect marks a submittal “Provide as Corrected,” the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
    c. Returned for Resubmittal: When the Architect marks a submittal “Revise and Resubmit,” do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay.
        1) Do not use, or allow others to use, submittals marked “Revise and Resubmit” at the Project Site or elsewhere where Work is in progress.
    d. Returned for Resubmittal: When the Architect marks a submittal “Rejected”, the Architect has not completed a full review, because it is clear that the submittal does not reflect the requirements of the Contract Documents. Do not proceed with work covered by the submittal, including purchasing, fabrication, delivery or other activity. Revise or prepare a new submittal that complies with the Contract Documents.
    e. Other Action: If the submittal is primarily for information purposes, record purposes, special processing, or other contractor activity, the submittal will be returned marked “Reviewed for General Conformance Only”. These submittals have been received and processed for information only and not approved or disapproved by the architect.

C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with Contract Document requirements.

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D. Submittals not required by the Contract Documents will not be reviewed and will be discarded or returned without action.

END OF SECTION 013300

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SECTION 014000 - QUALITY 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 quality assurance and quality control.

B. Testing and inspecting 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. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, and Construction Manager or authorities having jurisdiction are not limited by provisions of this Section.
   4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

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

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

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

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

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

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

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

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

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

J. Experienced: Unless otherwise indicated in individual Specification sections, 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.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

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

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

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

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

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 14 calendar days of Notice to Proceed, and not less than seven calendar days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

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

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

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections." Refer to Section 014100 “Special Inspections and Structural Testing”.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority, if applicable.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into

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compliance with standards of workmanship established by Contract requirements and approved mockups.

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

1.8 REPORTS AND DOCUMENTS

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

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

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

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5. Other required items indicated in individual Specification Sections.

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

1.9 QUALITY ASSURANCE

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

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

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

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

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

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

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

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

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

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

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

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

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

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2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections.

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Construction Manager and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Construction Manager 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.

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5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect and Construction Manager testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Refer to Specification Section 014100 “Special Inspections and Structural testing”.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

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B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect and Construction Manager reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 - Execution.

B. Protect construction exposed by or for quality-control service activities.

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

END OF SECTION 014000

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SECTION 014200 - REFERENCES

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 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect, Construction Manager, or Owner. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

J. "Installer": 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. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

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K. "Experienced": When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 014200

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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.

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 Architect, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required 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.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
   1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
   2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
   3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these

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operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

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.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1 and local jurisdictional requirements, whichever is more stringent.

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 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

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A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Contractor's Field Office: Of sufficient size to accommodate needs of Construction Manager , 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 sufficient size to accommodate meetings of 12 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-footsquare tack and marker boards.
   3. Drinking water and private toilet.
   4. Coffee machine and supplies.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: Use of permanent HVAC system is not permitted during construction.

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.

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

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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. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

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: Provide temporary heating 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. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
      a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
      b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
   1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
   1. At each telephone, post a list of important telephone numbers.

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a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 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 of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated or within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

D. 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.

E. Parking: Provide temporary parking areas for construction personnel.

F. 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.

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G. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
   1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated, or if not indicated, provide 4 foot by 8 foot sign comprised of ¾ inch exterior grade plywood mounted on 4 x 4 preservative treated wood posts set 4 feet into the ground. Sign content and layout as directed by Architect. Submit shop drawings for approval prior to fabrication and installation.
   2. Prepare temporary signs to provide directional information to construction personnel and visitors.
   3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
   4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
   5. Maintain and touchup signs so they are legible at all times.

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 Elevator Use: Use of elevators is not permitted.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Section 011000 - Summary .

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C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 - Site Clearing and/or Stormwater Pollution Prevention Plan (SWPPP).

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Comply with requirements specified in Section 311000 - Site Clearing.

F. 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.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

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2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

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.

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a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 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.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. 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

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SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.3 RELATED REQUIREMENTS

A. Section 329300 - Plants for maintenance of replacement plants if required.

1.4 REFERENCE STANDARDS

A. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning).

1.5 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height.

B. DBH: Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 4 inches or greater as measured at a height of 6 inches above the ground.

C. Dripline: Vertical projection to the ground surface from the furthest lateral extent of a tree or shrub canopy.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree Canopy: The layer of leaves, branches, and stems of trees that cover the ground when viewed from above.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings or defined by a circle concentric with each tree with a radius 12 times the tree's caliper size or defined by the dripline of the tree canopy.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.6 PREINSTALLATION MEETINGS

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A. Preinstallation Conference: Conduct conference at Project Site.
   1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
      a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
      b. Arborist's responsibilities.
      c. Quality-control program.
      d. Coordination of Work and equipment movement with the locations of protection zones.
      e. Trenching by hand or with air spade within protection zones.
      f. Field quality control.

1.7 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
   2. Detail fabrication and assembly of protection-zone fencing and signage.
   3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
   1. Species and size of tree.
   2. Location on site plan. Include unique identifier for each.
   3. Reason for pruning.
   4. Description of pruning to be performed.
   5. Description of maintenance following pruning.

D. Qualification Data: For Arborist and tree service firm.

E. Certification: From Arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

F. Maintenance Recommendations: From Arborist, for care and protection of trees affected by construction during and after completing the Work.

G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or video recordings.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

H. Quality-control program.

1.8 QUALITY ASSURANCE

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A. Arborist Qualifications: Certified Arborist as certified by ISA or Registered Consulting Arborist as designated by ASCA.

B. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the Arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.9 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
1. Planting Soil: Planting soil as specified in Section 329113 - Planting Soil.

B. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.
1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch-diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch-OD line posts, and 2-7/8-inch-OD corner and pull posts; with 0.177-inch-diameter top tension wire and 0.177-inch-diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
a. Height: 48 inches.

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

PART 3 EXECUTION

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3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by Arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue vinyl tape around each tree trunk, or around groups of plants, at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
   1. Apply 3-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   2. Access Gates: Install; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.

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2. Temporary access is permitted subject to preapproval in writing by Arborist if a root buffer effective against soil compaction is constructed as directed by Arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate and trench up to edge of protection zones according to requirements in Division 31 Sections unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots less than 2-inches diameter that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Root pruning shall be performed as directed by Arborist.

B. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Division 31 Sections.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by Arborist.
1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees according to ANSI A300 Part 1.
   a. Type of Pruning: Raising and reducing.

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B. Unless otherwise directed by Arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by Arborist.

F. Chip removed branches and spread with Protection Zone as mulch or dispose of off-site.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by Arborist unless otherwise indicated.
   1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller, less than 2-inch diameter roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified Arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
   1. Submit details of proposed pruning and repairs.
   2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to Arborist's written instructions.
   3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 40 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Arborist determines are incapable of restoring to normal growth pattern.
   1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 3-inches or smaller in caliper size.
   2. Large Trees: Provide new tree(s) of 3-inch caliper size. The number of trees to be provided shall be calculated using the Trunk Formula Technique as described in Guide for Plant Appraisal, current edition, by Council of Tree and Landscape Appraisers.

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a. Species: As selected by Architect.

3. Plant and maintain new trees as specified in Section 329300 - Plants.

C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 3-inch uniform thickness to remain.

D. Soil Aeration: Where directed by Arborist, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch-diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand and/or compost.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 015639

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SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENTATION CONTROL (TESC)

PART 1 GENERAL

1.1 SCOPE

A This section covers work to implement structural and nonstructural best management practices (BMPs) to control soil erosion by wind or water and keep eroded sediments and other construction-generated pollutants from moving off project sites. Requirements described in this section and shown on drawings are part of the project Temporary Erosion and Sedimention Control Plan (TESC Plan) and are the minimum for all project construction sites and conditions. This specification covers all project activities, including material sources, disposal sites, and offsite mitigation areas unless specific project activities are excluded elsewhere in this specification or in other contract documents controlling the work.

B Temporary and permanent erosion and sedimentation controls include grassing and mulching of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits. Acceptable limits are as established by Section 402 of the Federal Clean Water Act and applicable codes, ordinances, rules, regulations, and laws of state, local, and municipal authorities having jurisdiction (AHJ). For installation and maintenance guidance, refer to the Manual for Erosion and Sediment Control in Georgia, latest edition.

C Other Regulations: A local government erosion and sediment control permit may apply and some local agency requirements may be more stringent than this specification.

1.2 SYSTEM DESCRIPTION

A Erosion and Sediment Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases during construction period.

B Erosion and Sediment Control (ESC) Qualified Personnel:

1. Identify the ESC Qualified Personnel at the preconstruction discussions and in the TESC Plan. The ESC Qualified Personnel shall have certification in construction site erosion and sediment control as required by State and Local juristictional requirements.
2. The ESC Qualified Personnel shall implement the TESC Plan, including the following:
   a. Installing and maintaining all temporary erosion and sediment control BMPs included in the TESC Plan to assure continued performance of their intended function. Damaged or inadequate TESC BMPs shall be corrected immediately.
   b. Updating TESC Plan to reflect current field conditions.
   c. Terminating TESC Plan.
3. When a TESC Plan is included in the contract plans, ESC Qualified Personnel shall also inspect all areas disturbed by construction activities, all onsite erosion and sediment control Best Management Practices (BMPs), all stormwater discharge points, and all temporarily stabilized inactive sites per schedule in the Local Erosion Control Permit or as directed by Engineer. Complete erosion and sediment control inspection form provided by AHJ for each inspection and submit a copy to Engineer no later than end of the next working day following inspection.

C Personnel Training: Prior to commencement of construction, responsible personnel must have an understanding of the State or Local Erosion Control Permit requirements and their specific

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responsibilities under the permit. At a minimum, personnel must be trained to understand the following as it relates to the scope of their job duties:

1. The location of all stormwater controls and how to maintain them.
2. Procedures for complying with the pollution prevention requirements.
3. Procedures for conducting inspections, recording findings, and taking corrective action.
4. Creation and maintenance of required documentation and files.

D Temporary Erosion and Sediment Control Plan (Stormwater Pollution Prevention Plan):

1. A Draft TESC Plan is furnished as part of the drawings, which helps fulfill part of the plan requirement of the Local Erosion Control Permit. This initial TESC Plan may be used as the basis of the construction TESC Plan. Additional or revised erosion and sediment control features, not shown on the initial TESC Plan, may be required depending on methods of operation and schedule.
2. For each phase of the scheduled work indicated on the TESC Plan, all the BMPs proposed and installed for erosion and sediment control during construction shall be noted on an updated TESC Plan, which also includes all temporary slopes.
3. Required minimum elements included in the TESC Plan and SWPPP are provided by the AHJ's erosion control manual and NPDES permit.
4. Active TESC Plan and implementation schedules must be prepared by a competent and qualified individual per State and/or local requirements. Furnish a signed copy of the TESC Plan with individual's name, title, state certifications, and employing firm if different than Contractor's firm.
5. Do not begin any Site activities that have potential to cause erosion or sediment movement until the TESC Plan and implementation schedules are approved by Engineer.
6. Keep a copy of the approved, active TESC Plan with updated changes onsite during all construction activities.
7. Continually update the TESC Plan and implementation schedules as needed for unexpected storm or other events to ensure that sediment-laden water does not leave the construction site. Changes to the TESC Plan shall be incorporated no later than 24 hours after implementation.

E Owner or Engineer may identify additional temporary control measures if it appears pollution or erosion may result from weather, nature of materials, or progress on the work.

F Install all sediment control devices including, but not limited to, sediment ponds, perimeter silt fencing, or other sediment trapping BMPs prior to any ground disturbing activity. Do not expose more erodible earth than necessary during clearing, grubbing, excavation, borrow, or fill activities without written approval by Engineer. Engineer may increase or decrease the limits based on project conditions. Erodible earth is defined as any surface where soils, grinding, or other materials may be capable of being displaced and transported by rain, wind, or surface water runoff. Cover inactive areas of erodible earth, whether at final grade or not, within specified time period per Local permit requirements, using an approved soil covering practice. Phase clearing and grading to maximum extent practical to prevent exposed inactive areas from becoming a source of erosion.

G Water Management:

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1. Manage site water in accordance with the conditions of the waste discharge permit from a local permitting authority. If site water management is not subject to permit, manage as follows:
    a. Groundwater: When groundwater is encountered in an excavation, treat and discharge as follows:
        1) When groundwater conforms to State or local jurisdictional Water Quality Standards, it may bypass detention and treatment facilities and be routed directly to its normal discharge point at a rate and method that will not cause erosion.
        2) When turbidity of groundwater is similar to turbidity of site runoff, groundwater may be treated using same detention and treatment facilities being used to treat the site runoff and then discharged at a rate that will not cause erosion.
        3) When groundwater turbidity is greater than turbidity of site runoff, treat groundwater separately until turbidity is similar to or better than site runoff, and then it may be combined with site runoff and treated as described above.
    b. Process Water:
        1) Do not discharge high pH process water or wastewater (non-stormwater) that is generated onsite, including water generated during concrete grinding, rubblizing, washout, and hydrodemolition activities, to waters of the jurisdiction, including wetlands. Water may be infiltrated upon approval of Engineer. Offsite disposal of concrete process water is subject to approval of Engineer.
        2) Treat all water generated onsite from construction or washing activities that is more turbid than site runoff separately until turbidity is the same or less than site runoff, and then it may be combined with site runoff and treated as described above. Water may be infiltrated upon approval of Engineer.
    c. Offsite Water: Prior to disruption of normal watercourse, intercept offsite stormwater and pipe it either through or around the project site. This water shall not be combined with onsite stormwater. Discharge offsite water at its preconstruction outfall point preventing an increase in erosion below the site. Submit proposed method for performing this work for Engineer's approval.

H Dispersion/Infiltration: Convey water only to dispersion or infiltration areas designated in the TESC Plan or to sites approved by Owner. Water shall be conveyed to designated dispersion areas at a rate such that, when runoff leaves the area and enters waters of the jurisdiction, the required turbidity standards are achieved. Convey water to designated infiltration areas at a rate that does not produce surface runoff.

I Detention/Retention Pond Construction: Whether permanent or temporary, construct before beginning other grading and excavation work in the area that drains into that pond. Install temporary conveyances concurrently with grading in accordance with the TESC Plan so that newly graded areas drain to the pond as they are exposed.

J Pollution Control: Use BMPs to prevent or minimize stormwater exposure to pollutants from spills; vehicles and equipment fueling, maintenance, and storage; other cleaning and maintenance activities; and waste handling activities. These pollutants include fuel, hydraulic fluid, and other oils from vehicles and machinery, as well as debris, leftover paints, solvents, and glues from construction operations. Implement the following BMPs when applicable:

1. Written spill prevention and response procedures
2. Employee training on spill prevention and proper disposal procedures
3. Spill kits in all vehicles
4. Regular maintenance schedule for vehicles and machinery
5. Material delivery and storage controls
6. Training and signage
7. Covered storage areas for waste and supplies

K If Owner or Engineer orders the work suspended, continue to control erosion, pollution, and runoff during the shutdown.

L Nothing in this section shall relieve Contractor from complying with other contract requirements.

1.3 SUBMITTALS

A Submit product data in accordance with the requirements of Section 01 33 00 of these Specifications.

B Prior to any construction activity, the Contractor shall submit, for the Engineer's approval, a schedule for the accomplishment of temporary and permanent erosion and sedimentation control work. No work shall be started until the erosion and sedimentation control schedule and methods of operation have been approved by the Engineer.

C When a TESC Plan is included on drawings, either adopt or modify the TESC Plan. Provide a schedule for TESC Plan implementation and incorporate it into Contractor’s progress schedule. Obtain Engineer’s approval of the TESC Plan and schedule before any work begins.

D Modified TESC Plans shall meet all requirements of the applicable jurisdictions.

E The TESC Plan shall cover all areas that may be affected inside and outside the limits of the project (including all Owner-provided sources, disposal sites, and haul roads, and all nearly land, streams, and other bodies of water).

F Allow at least 5 working days for Engineer to review any original or revised TESC Plan. Failure to approve all or part of any such plan shall not make Owner liable to Contractor for any work delays.

G Provide proposed changes to the TESC plans for approval by the Engineer per jusristrictional requirements. Allow at least 5 working days for Engineer to review, approve and incorporated any revisions to the current TESC Plan.

1.4 QUALITY ASSURANCE

A The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum requirements. Any additional erosion and sedimentation control measures required by the Contractor's means, methods, techniques and sequence of operation will be installed by the Contractor at no additional cost to the Owner.

B Perform all work under this Section in accordance with all pertinent rules and regulations including, but not necessarily limited to, those stated in these Specifications. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.

C Provide all materials and promptly take all actions necessary to achieve effective erosion and sedimentation control in accordance with the Erosion and Sedimentation Act of 1975, local ordinances, other permits, local enforcing agency guidelines and these Specifications.

D Basic Principles

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1. Coordinate the land disturbance activities to fit the topography, soil types and conditions.
2. Minimize the disturbed area and the duration of exposure to erosive elements.
3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
4. Safely convey run-off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
5. Retain sediment on-site that was generated on-site.
6. Minimize encroachment upon watercourses.

E Implementation

1. The Contractor is solely responsible for the control of erosion within the Project site and the prevention of sedimentation from leaving the Project site or entering waterways.
2. The Contractor shall install temporary and permanent erosion and sedimentation controls which will ensure that runoff from the disturbed area of the Project site shall pass through a filter system before exiting the Project site.
3. The Contractor shall provide temporary and permanent erosion and sedimentation control measures to prevent silt and sediment from entering the waterways. The Contractor shall maintain the required undisturbed vegetative buffer along any on-site stream, pond or regulated waterway, per State and local regulations. If disturbance of a vegetative buffer is permitted, the Contractor shall exercise extreme care during land disturbance operations within this buffer to prevent degradation of the stream, pond or regulated waterway.
4. The Contractor shall limit land disturbance activity to those areas shown on the Drawings.
5. The Contractor shall maintain erosion and sedimentation control measures within disturbed areas on the entire site at no additional cost to the Owner until the acceptance of the Project. Maintenance shall include mulching, re-seeding, clean-out of sediment barriers and sediment ponds, replacement of washed-out or undermined rip rap and erosion control materials, to the satisfaction of the Engineer.
6. All fines imposed for improper erosion and sedimentation control shall be paid by the Contractor.
7. The Contractor shall use all means necessary to control dust on and near the work and all off-site borrow areas, in accordance to the Manual for Erosion and Sediment Control in Georgia, latest edition. The Contractor should thoroughly moisten all surfaces and/or control dust within the acceptable means and methods required by State and local regulations, as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of work on the site.

F References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement

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documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
ASTM C139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D822/D822M	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D977	Standard Specifications for Anionic Emulsified Asphalt
ASTM D2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and other Organic Soils
ASTM D3776/D3776M	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D3786/D3786M	Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
ASTM D4355/D4355M	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D4491/D4491M	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D5035	Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
ASTM D6459	Standard Test method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion

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Reference	Title
ASTM D6460	Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion
ASTM M6475	Standard Test Method for Measuring mass per Unit Area of Erosion Control Blankets
ASTM D7322/D7322M	Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions
ASTM D7367	Standard Test Method for Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting
ASTM G23	Standard Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetalic Materials
National Stone, Sand and Gravel Association (NSSGA)	Quarried Stone for Erosion and Sediment Control, 1991
NWS	Precipitation-Frequency of the United States by State/Territory, 2012
NWS	Precipitation Frequency Data Server, 2012
USDA NRCS	Urban Hydrology for Small Watersheds; 1986. Technical Release 55

PART 2 PRODUCTS

2.1 GEOTEXTILE

A Geotextiles shall consist only of long chain polymeric fibers or yarns formed into a stable network such that the fibers or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the material shall be polyolefins or polyesters. The material shall be free from defects or tears. Geotextile shall also be free of any treatment or coating which might adversely alter its hydraulic or physical properties after installation. Geotextile properties as described in Tables 1-3.

Table 1. Geotextile for Permanent Erosion Control

Geotextile Property	ASTM Test Method	Geotextile Property Requirements					
		Permanent Erosion Control				Ditch Lining	
		Moderate Survivability		High Survivabiilty			
		Woven	Non-woven	Woven	Non-woven	Woven	Non-woven
AOS	D4751	See Table 2		See Table 2		U.S. No. 30 max.	
Water permittivity	D4491	See Table 2		See Table 2		0.02 sec-1 min.	
Grab tensile strength, in machine and x-machine direction	D4632/ D4632M	250 lb. min.	160 lb. min.	315 lb. min.	200 lb. min.	250 lb. min.	160 lb. min.

Table 1. Geotextile for Permanent Erosion Control

Geotextile Property	ASTM Test Method	Geotextile Property Requirements					
		Permanent Erosion Control				Ditch Lining	
		Moderate Survivability		High Survivabiilty			
		Woven	Non-woven	Woven	Non-woven	Woven	Non-woven
Grab failure strain, in machine and x-machine direction	D4632/ D4632M	15% -50%	≥ 50%	15% -50%	≥ 50%	< 50%	≥ 50%
Seam breaking strength	D4632/ D4632M	220 lb. min.	140 lb. min.	270 lb. min.	180 lb. min.	220 lb. min.	140 lb. min.
Puncture resistance	D6241	495 lb. min.	310 lb. min.	620 lb. min.	430 lb. min.	495 lb. min.	310 lb. min.
Tear strength, in machine and x-machine direction	D4533	80 lb. min.	50 lb. min.	112 lb. min.	79 lb. min.	80 lb. min.	50 lb. min.
Ultraviolet (UV) radiation stability	D4355	70% strength retained min., after 500 hours in xenon arc device					

Table 2. Filtration Properties for Geotextile for Permanent Erosion Control

Geotextile Property	ASTM Test Method	Geotextile Property Requirements		
		Class A	Class B	Class C
AOS	D4751	U.S. No. 40 max.	U.S. No. 60 max.	U.S. No. 70 max.
Water permittivity	D4491	0.7 sec-1 min.	0.4 sec-1 min.	0.2 sec-1 min.

Table 3. Geotextile for Temporary Silt Fence

Geotextile Property	ASTM Test Method	Geotextile Property Requirements	
		Unsupported Between Posts	Supported Between Posts with Wire or Polymeric Mesh
AOS	D4751	U.S. No. 30 max. for silt wovens, U.S. No. 50 for all other geotextile types, U.S. No. 100 min.	
Water permittivity	D4491	0.2 sec-1 min.	
Grab tensile strength, in machine and x-machine direction	D4632/ D4632M	180 lb. min. in machine direction, 100 lb. min. in x-machine direction	100 lb. min.

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Table 3. Geotextile for Temporary Silt Fence

Geotextile Property	ASTM Test Method	Geotextile Property Requirements	
		Unsupported Between Posts	Supported Between Posts with Wire or Polymeric Mesh
Grab failure strain, in machine and x-machine direction	D4632/ D4632M	30% max. at 180 lb. or more	
Ultraviolet (UV) radiation stability	D4355	705 strength retained min., after 500 hours in xenon arc device	

2.2 SEDIMENT BARRIERS

A Silt Fence

1. Silt fence shall meet the requirements of Manual for Erosion and Sediment Control in Georgia, latest edition.
2. Reinforced silt fence is a combination of silt fence fabric with woven wire reinforcement. Reinforced silt fence woven wire reinforcement shall meet the requirements of Manual for Erosion and Sediment Control in Georgia, latest edition.
3. Silt fence fabric shall meet the requirements of Section 2.01, Geotextiles.

2.3 INLET PROTECTION

A Sediment Barrier Inlet Protection

1. Filter Fabric with Supporting Frame: Reinforced silt fence supported by steel posts shall be used to encompass inlet. See Silt Fence this Part.
2. Wattles Fiber Rolls: Product shall be used to encompass inlet. See Wattles Fiber Rolls this Part.
3. Compost Sock: Compost socks shall be used to encompass inlet. See Compost Sock this Part.
4. Sand Bag Barrier: Sand Bag Barriers shall be used to encompass inlet. See Sand Bag Barrier this Part.

B Curb Inlet Protection

1. Wrapped Masonary Units: Concrete blocks shall be standard 8 inch x 8 inch x 16 inch concrete masonry units and shall be in accordance with ASTM C139, Concrete Masonry Units for Construction and wrapped in filter fabric. Filter fabric shall be in shall be polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 ounces per square yard and meet the following criteria:
   a. Greater than 300 psi Mullen Burst Strength using ASTM D3786/D3786M Standard Test Method forHydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
   b. Greater than 70 percent UV Stability using ASTM D4355/D4355M Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus.

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2. Gravel Curb Inlet Filter: Gravel bags constructed by wrapping 1/2 to 3/4 inch gravel with filter fabric meeting criteria in this sub-section, wire, plastic mesh, or equivalent material and encompassing inlet.
3. Sand Bag Barrier: Sand Bag Barriers shall be used to encompass inlet. See Sand Bag Barrier this Part.

C Pre-fabricated Frame and Filter assembly: Refer to manufacturer's specifications for product list.

D Inlet Inserts [Silt Sack]: Refer to manufacturer's specifications for product list.

2.4 CONSTRUCTION EXIT

A Stone: Use sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be in accordance with the NSSGA Size R-2 (1.5 to 3.5-inch stone).

B Geotextile: The geotextile underliner must be placed the full length and width of the entrance. Geotextile selection shall be based on AASHTO M288-98 specification:

1. For subgrades with a CBR greater than or equal to 3 or shear strength greater than 90 kPa, geotextile must meet requirements of section AASHTO M288-96 Section 7.3, Separation Requirements.
2. For subgrades with a CBR between 1 and 3 or sheer strength between 30 and 90 kPa, geotextile must meet requirements of section AASHTO M288-96 Section 7.4, Stabilization Requirements.

2.5 EROSION CONTROL MATTING AND BLANKETS

A All blanket and matting materials shall be according to Manual for Erosion and Sediment Control in Georgia, latest edition.

B Temporary erosion control blanket shall be made of natural plant fibers. Supply independent test results meeting the following:

Properties	ASTM Test Method	Requirements
Protecting slopes from rainfall-induced erosion	D6459: Test in one soil type. Soil tested shall be sandy loam as defined by the NRCS Soil Texture Triangle.	Maximum C factor of 0.15 using revised universal soil loss equation (RUSLE)
Dry weight per unit area	D6475	0.36 lb./sq. yd. minimum
Performance in protecting earthen channels from stormwater-induced erosion	D6460: Test in one soil type. Soil tested shall be loam as defined by the NRCS Soil Texture Triangle.	1.0 lb/sq. ft. minimum
See germination enhancement	D7322	200 percent minimum
Netting, if present, shall be biodegradable with a life span not to exceed 1 year.		

C Temporary Erosion Control Blankets: Use in concentrated flow areas, all slopes steeper than 3:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with the appropriate erosion control matting or blankets.

1. Straw blankets: Shall consist of weed-free straw from agricultural crops formed into a blanket. Blankets shall have a top side of photodegradable plastic mesh with a maximum mesh size of 5/16 x 5/16 inch sewn to the straw with biodegradable thread that is

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appropriate for slopes. The blanket shall have a minimum thickness of 3/8 inch and minimum dry weight of 0.5 pounds per square yard.

2. Excelsior blankets: Shall consist of curled wood excelsior (80% of fibers are six inches or longer) formed into a blanket. The blanket shall have clear markings indicating the top side of the blanket and be smolder resistant. Blankets shall have photodegradable plastic mesh having a maximum mesh size of 1 1/2x3 inches. The blanket shall have a minimum thickness of 1/4 of an inch and a minimum dry weight of 0.8 pounds per square yard. Slopes require excelsior matting with the top side of the blanket covered in the plastic mesh, and for waterways, both sides of the blanket require plastic mesh.
3. Coconut fiber blankets: Shall consist of 100% coconut fiber formed into a blanket. The minimum thickness of the blanket shall be 1/4 of an inch with a minimum dry weight of 0.5 pounds per square yard. Blankets shall have photodegradable plastic mesh, with a maximum mesh size of 5/8 x 5/8 inch and sewn to the fiber with a breakdown resistant synthetic yarn. Plastic mesh is required on both sides of the blanket if used in waterways. A maximum of two inches is allowable for the stitch pattern and row spacing.
4. Wood fiber blankets: Shall consist of reprocessed wood fibers that does not possess or contain any growth or germination inhibiting factors. The blanket shall have a photodegradable plastic mesh, with a maximum mesh size of 5/8 x 3/4 inch, securely bonded to the top of the mat. The blanket shall have a minimum dry weight of 0.35 pounds per square yard. A maximum of two inches is allowable for the stitch pattern and row spacing. This practice shall be applied only to slopes.
5. Jute Mesh: To be applied to slopes. Jute mesh with a 48 inch width shall show between 76 and 80 warpings and a one yard length shall show between 39 to 43 weftings. The woven mesh shall be at least 45 inches wide. Yarn shall have a unit weight of at least 0.9 pounds per square yard, but not more than 1.5 pounds per square yard.

D Permanent Erosion Control Blankets: Use in concentrated flow areas, all slopes steeper than 3:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with the appropriate erosion control matting or blankets.

1. Permanent matting shall consist of a lofty web of mechanically or melt bonded polymer nettings, monofilaments or fibers which are entangled to form a strong and dimensionally stable matrix. Polymer welding, thermal or polymer fusion, or the placement of fibers between two high strength, bi-axially oriented nets bound securely together by parallel lock stitching with polyolefin, nylon or polyester threads are all appropriate bonding methods. Mats shall maintain their shape before, during, and after installation, under dry or water saturated conditions. Mats must be stabilized against ultraviolet degradation and shall be inert to chemicals normally encountered in a natural soil environment.
2. The mat shall conform to the following physical properties:

Property	Minimum Value
Thickness	0.5 inch
Weight	0.6 PSY
Roll Width	38 inches
Tensile Strength (ASTM D5035-6" strip)	
Length (50% elongation)	15 lbs./in.

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Property	Minimum Value
Length (ultimate)	20 lbs./in.
Width (50% elongation)	5 lbs./in.
Width (ultimate)	10 lbs./in.
Ultraviolet Stability (1000hrs. in an Atlas ARC Weatherometer, ASTM G 23, Type D in accordance with ASTM D 822)	80%

E Stapling and Anchoring Materials:

1. Temporary Blankets: Staples shall be used to anchor temporary blankets. U-shaped wire (11 gauge or greater) staples with legs at least 6 inches in length and a crown of one inch or appropriate biodegradable staples can be used. Staples shall be of sufficient thickness for soil penetration without undue distortion.
2. Permanent Matting: Sound wood stakes, 1x3 inches stock sawn in a triangular shape, shall be used. Depending on the compaction of the soil, select stakes with a length from 12 to 18 inches. U-shaped staples shall be 11 gauge steel or greater, with legs at a minimum of 8 inches length with a 2 inch crown.

2.6 TOPSOILING

A Topsoil should be friable and loamy, free of debris, objectionable weeds and stones and contain no toxic substance that may be harmful to plant growth. A pH range of 5.0-7.5 is acceptable. Soluble salts should not exceed 500 ppm. Refer to specification 32 91 19.13 Topsoil.

B Topsoil stockpiles shall be contained by sediment barriers to prevent sedimentation on adjacent areas. Stockpiles shall be stabilized in accordance with specifications for Temporary Mulching and Temporary Grassing, or Polyacrylamide (PAM), specified in this Part.

2.7 TEMPORARY MULCHING

A Dry straw: Shall be applied at a depth of 2 to 4 inches providing complete soil coverage. Material shall be clean, seed-free cereal straw.

B Wood waste (chips, sawdust or bark): Shall be applied at a depth of 2 to 3 inches. Organic material from the clearing stage of development should remain on site, be chipped, and applied as mulch.

C Mulch Binder: Mulch on slopes exceeding 3 (horizontal) to 1 (vertical) shall be held in place by the use of a mulch binder, as approved by the Engineer. The mulch binder shall be non toxic to plant and animal life and shall be approved by the Engineer.

2.8 TEMPORARY GRASSING

A Grassing materials shall meet the requirements of the Manual for Erosion and Sediment Control in Georgia, latest edition.

B Seed rate, fertilization, lime application and other requirements shall be provided as shown on the Drawings.

C Water: Water shall be free of excess and harmful chemicals, organisms and substances which may be harmful to plant growth or obnoxious to traffic. Salt or brackish water shall not be used. Water shall be furnished by the Contractor.

2.9 PERMANENT GRASSING & SODDING

A Refer to specifications 32 92 19.13 - Top Soiling, Seeding, and Sodding.

PART 3 EXECUTION

3.1 GENERAL

A Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the Engineer, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices to control erosion and sedimentation on the site at no additional cost to the Owner.

B All erosion and sedimentation control devices and structures shall be inspected by the ESC Qualified Personnel, as defined by State and local regulations, whichever is more stringent. Frequency of all inspections shall be determined by State and/or local permit requirements as outlined in the prepared TESC, Stormwater Pollution Prevention Plan (SWPPP) and State and local permit regulations.

C All erosion and sedimentation control measures and devices shall be constructed and maintained as indicated on the Drawings, in the prepared SWPPP, or specified herein until adequate permanent disturbed area stabilization has been provided and accepted by the Engineer. Once adequate permanent stabilization has been provided and accepted by the Engineer, all temporary erosion and sedimentation control structures and devices shall be removed.

D Construction activities must avoid or minimize excavation and creation of bare ground during wet weather.

E The intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.

F Inspect BMPs in accordance with the schedule in the State and/or local permit or as directed by Engineer.

G Complete an inspection report within 24 hours of an inspection. Each inspection report shall be signed and identify corrective actions. Document that corrective actions are performed within 7 days of identification. Keep a copy of all inspection reports at the site or at an easily accessible location.

H Initiate repair or replacement of damaged erosion and sediment control BMPs immediately and work completed by end of next work day. Significant replacement or repair must be completed within 7 days, unless infeasible.

I Within 24 hours, remediate any significant sediment that has left construction site. Investigate cause of the sediment release and implement steps to prevent a recurrence of discharge within same 24 hours. Perform in-stream cleanup of sediment according to applicable regulations.

J At end of each work day, stabilize or cover soil stockpiles or implement other BMPs to prevent discharges to surface waters or conveyance systems leading to surface waters.

K Temporarily stabilize soils at end of shift before holidays and weekends, if needed. Ensure soils are stable during rain events at all times of year.

L Initiate stabilization by no later than end of next work day after construction work in an area has stopped permanently or temporarily.

M Provide permanent erosion control measures on all exposed areas. Do not remove temporary sediment control practices until permanent vegetation or other cover of exposed areas is established. However, do remove all temporary erosion control measures as exposed areas become stabilized, unless doing so conflicts with local requirements. Properly dispose of construction materials and waste, including sediment retained by temporary BMPs.

3.2 INSTALLATION AND MAINTENANCE OF EROSION AND SEDIMENT CONTROLS

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A Sediment Barriers
1. Sediment barriers shall not be used in any flowing stream, creek or river.
2. Sediment barriers shall be installed as shown on the Drawings and as directed by the Engineer.
3. Along stream buffers and other sensitive areas, two rows of reinforced silt fence or one row of reinforced silt fence backed by haybales shall be used.
4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one-third of the original height of the barrier or as directed by the Engineer. Torn, damaged, destroyed or washed-out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
5. Sediment Barrier Removal
   a. Sediment barriers shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.
   b. Accumulated sediment shall be removed from the barrier and spread over the site.
   c. All non-biodegradable parts of the barrier shall be disposed of properly. The straw bales may be spread evenly across disturbed areas as a mulching material.
   d. The disturbed area created by barrier removal shall be permanently stabilized.

B Inlet Sediment Traps
1. Inlet Sediment Traps shall be installed as shown on the Drawings and as directed by the Engineer.
2. For each Inlet Sediment Traps type the following installation guidelines shall be used:
   a. Filter Fabric with Supporting Frame: Reinforced silt fence supported by steel posts shall be used. The stakes shall be spaced evenly around the perimeter of the inlet a maximum of 3 feet apart, and securely driven into the ground, approximately 18 inches deep. The fabric shall be entrenched 12 inches and backfilled with crushed stone or compacted soil. Fabric and wire shall be securely fastened to the posts, and fabric ends must be overlapped a minimum of 18 inches or wrapped together around a post to provide a continuous fabric barrier around the inlet.
   b. Baffle Box: The baffle box shall be constructed of 2" x 4" boards spaced a maximum of 1 inch apart or of plywood with weep holes 2 inches in diameter. The weep holes shall be placed approximately 6 inches on center vertically and horizontally. Gravel shall be placed outside the box, all around the inlet, to a depth of 2 to 4 inches. The entire box is wrapped in filter fabric that shall be entrenched 12 inches and backfilled.
   c. Block and Gravel Drop Inlet Protection: One block is placed on each side of the structure on its side in the bottom row to allow pool drainage. The foundation shall be excavated at least 2 inches below the crest of the storm drain. The bottom row of blocks are placed against the edge of the storm drain for lateral support and to avoid washouts when overflow occurs. If needed, lateral support shall be given to subsequent rows by placing 2" x 4" wood studs through block openings. Hardware cloth or comparable wire mesh with 1/2 inch openings shall be fitted over all block openings to hold gravel in place. Clean gravel shall be placed 2 inches below the top of the block on a 2:1 slope or flatter and smoothed to an even grade.

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d. Gravel Drop Inlet Protection: Stone and gravel are used to trap sediment. The slope toward the inlet shall be no steeper than 3:1. A minimum 1 foot wide level stone area shall be left between the structure and around the inlet to prevent gravel from entering the inlet. On the slope toward the inlet, stone 3 inches in diameter and larger shall be used. On the slope away from the inlet, 1/2 to 3/4 inch gravel shall be used at a minimum thickness of 1 foot.

e. Excavated Inlet Sediment Trap: The sediment trap shall be placed immediately around the inlet. The excavation shall be constructed immediately outside of the sediment trap and provide a minimum depth of 1.5 feet for sediment storage.

f. Curb Inlet Protection: On existing paved areas or once new pavement areas have been installed, a curb inlet filter shall be installed on inlets receiving runoff from disturbed areas. A gap of approximately 4 inches shall be left between the inlet filter and the inlet to allow for overflow and prevent hazardous ponding in the roadway.

g. Pre-fabricated Frame and Filter assembly: Refer to manufacturer's specifications for installation and maintenance.

3. The trap shall be inspected daily and after each rain and repairs made as needed. Sediment shall be removed when the sediment has accumulated to one-third the height of the trap. Sediment shall be removed from curb inlet protection immediately. For excavated inlet sediment traps, sediment shall be removed when one-third of the sediment storage capacity has been lost to sediment accumulation.

4. Sediment Barrier Removal

a. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.

b. Accumulated sediment shall be removed from the barrier and spread over the site.

c. All non-biodegradable parts of the barrier shall be disposed of properly. The straw bales may be spread evenly across disturbed areas as a mulching material.

d. The disturbed area created by barrier removal shall be permanently stabilized.

C Check Dams

1. Check dams shall not be used in any flowing stream, creek or river.

2. Check dams shall be installed as shown on the Drawings and as directed by the Engineer.

3. Stone check dams:

a. Mechanical or hand placement shall be required to insure complete coverage of entire width of ditch or swale and that center of dam is lower than edges.

b. A geotextile should be used as a separator between the graded stone and the soil base and abutments. The geotextile shall be placed immediately adjacent to the subgrade without any voids and extend five feet beyond the downstream toe of the dam to prevent scour.

4. Straw Bale Check Dams: Stake and embed straw bales a minimum of 4 inches deep.

5. Height: The center of the check dam must be at least 9 inches lower than outer edges. Dam height should be 2 feet maximum measured to center of check dam.

6. Side Slopes: Side slopes shall be 2:1 or flatter.

7. Spacing: Two or more check dams in series shall be used for drainage areas greater than one acre. Maximum spacing between dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
8. Check dams shall be maintained to ensure the depth of impounded sediment is no more than one-third of the original height of the check dam or as directed by the Engineer. Damaged, destroyed or washed-out check dams shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
9. Check Dams removal
    a. Check dams shall be removed [shall remain] once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.
    b. Accumulated sediment shall be removed from the check dams and spread over the site.
    c. All non-biodegradable parts of the barrier shall be disposed of properly. The straw bales may be spread evenly across disturbed areas as a mulching material.
    d. The disturbed area created by check dam removal shall be permanently stabilized.

D Construction Exit

1. Construction Exit shall be placed as shown on the Drawings or as directed by the Engineer. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right-of-way, street, alley, sidewalk or parking area.
2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris. The geotextile underliner shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction.
3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights-of-way and paved surfaces as directed by theEngineer. This shall require periodic top dressing with 1.5-3.5 inch stone, as conditions demand.
4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public rights-of-way or paved surfaces has ceased and as directed by the Engineer.

E Polyacrylamide (PAM)

1. Application rates shall conform to manufacturer’s guidelines for application.
2. Maintenance will consist of reapplying anionic PAM to disturbed areas including high use traffic areas which interfere in the performance of this practice.

F Erosion Control Matting and Blankets

1. Erosion Control Matting and Blankets be placed as shown on the Drawings and as directed by the Engineer.
2. After the site has been shaped and graded to the approved design, prepare a friable seedbed relatively free from clods and rocks more than one inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface.

Surface must be smooth to ensure proper contact of blankets or matting to the soil surface. If necessary, redirect any runoff from the ditch or slope during installation.

3. Follow manufacturer's recommendations and follow details as shown on the Drawings for laying and stapling.
4. All erosion control blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining. Any dislocation or failure should be repaired immediately. If washouts or breakage occurs, reinstall the material after repairing damage to the slope or ditch. Continue to monitor these areas until they become permanently stabilized.

G Filter Ring

1. Filter Rings be placed as shown on the Drawings and as directed by the Engineer.
2. The filter ring shall be constructed at a height no less than two feet from grade.
3. Mechanical or hand placement of stone shall be required to uniformly surround the structure to be supplemented. Refer to Rip Rap, within this specification, for rock riprap specifications.
4. When utilized below a storm drain outlet, it shall be placed such that it does not create a condition causing water to back-up into the storm drain and inhibit the function of the storm drain system.
5. Maintenance: The filter ring must be kept clear of trash and debris. This will require continuous monitoring and maintenance, which includes sediment removal when one-half full. Structures are temporary and should be removed when the land-disturbing project has been stabilized.

H Rock Filter Dam

1. Mechanical or hand placement will be required to insure that the rock dam extends completely across the channel and securely ties into both channel banks. The center of the dam must be no less than six inches lower than the lowest side, to serve as a type of weir. Gabions can be installed to serve as rock filter dams, but should follow recommended sizing and installation specifications. Refer to Gabions in this specification.
2. Geotextiles should be used as a separator between the graded stone, the soil base, and the abutments. The geotextile should be placed immediately adjacent to the subgrade without any voids and extend five feet beyond the downstream toe of the dam to prevent scour.
3. Maintenance: Rock dams should be removed once disturbed areas have been stabilized. Periodic inspection and required maintenance must be provided. Sediment shall be removed when it reaches a depth of one-half of the original height of the dam.

I Retrofitting

1. Retrofit structures shall be placed as shown on the Drawings and as directed by the Engineer.
2. Perforated Half-Round Pipe with Stone Filter:
   a. Diameter of half-round pipe should be 1.5 times the diameter of the principal pipe outlet or wider than the greatest width of the concrete weir.
3. Shall be fixed by specified means (bolts, etc) to concrete outlet structure.
4. Slotted Board Dam with Stone:
   a. Shall be installed with minimum size 4x4 inch posts.
   b. Boards should have 0.5-1.0 inch space between them.

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5. Maintenance: Retrofit structures shall be kept clear of trash and debris. This will require continuous monitoring and maintenance, which includes sediment removal when one-third of the sediment storage capacity has been lost. Structures are temporary and shall be removed when disturbed areas have been permanently stabilized.

J Temporary Sediment Basin

1. Site Preparation: Areas under the embankment and under structural works shall be cleared, grubbed, and stripped of topsoil. All trees, vegetation, roots and other objectionable material shall be removed and disposed of by approved methods. In order to facilitate clean-out or restoration, the pool area (measured at the top of the pipe spillway) will be cleared of all brush and trees.
2. Cut-off Trench: A cut-off trench will be excavated along the centerline of earth fill embankments. The minimum depth shall be 2 feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling and compaction operations.
3. Embankment: The fill material shall be taken from approved areas shown on the Drawings. It shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks or other objectionable material. Relatively pervious materials such as sand or gravel (Unified Soil Classes GW, GP, SW & SP) shall be placed in the downstream section of the embankment. Areas on which fills are to be placed shall be scarified prior to placement of fill. The fill material shall contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Fill material shall be placed in six-inch to eight-inch thick continuous layers over the entire length of the fill. Compaction shall be obtained by routing and hauling the construction equipment over the fill so that the entire surface of the fill is traversed by at least one wheel or tread track of the equipment or by the use of a compactor. The embankment shall be constructed to an elevation 5 percent higher than the design height to allow for settlement.
4. Principal Spillway: The riser shall be securely attached to the pipe or pipe stub by welding the full circumference making a watertight structural connection. The pipe stub must be attached to the riser at the same percent (angle) of grade as the outlet conduit. The connection between the riser and the riser base shall be watertight. All connections between pipe sections must be achieved by approved watertight band assemblies. The pipe and riser shall be placed on a firm, smooth foundation of impervious soil as the embankment is constructed. Breaching the embankment is unacceptable. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the pipe or anti-seep collar. The fill material around the pipe spillway shall be placed in four inch layers and compacted under and around the pipe to at least the same density as the adjacent embankment. Care must be taken not to raise the pipe from firm contact with its foundation when compacting under the pipe haunches. A minimum depth of two feet of hand compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.

5. Emergency Spillway: The emergency spillway shall be installed in undisturbed ground. The achievement of planned elevations, grades, design width, entrance and exit channel slopes are critical to the successful operation of the emergency spillway and must be constructed within a tolerance of ± 0.2 feet. If the emergency spillway requires erosion protection other than vegetation, the lining shall not compromise the capacity of the emergency spillway, e.g. the emergency spillway shall be over-excavated so that the lining will be flush with the slope surface.
6. Vegetative Treatment: Stabilize the embankment and all other disturbed areas in accordance with the appropriate permanent vegetative measure, see Specification 32 92 19 Seeding, immediately following construction. In no case shall the embankment remain unstabilized for more than seven (7) days.
7. Erosion and Pollution Control: Construction operations will be carried out in such a manner that erosion and water pollution will be minimized. State and local law concerning pollution abatement shall be complied with.
8. Maintenance: Repair all damages caused by soil erosion or construction equipment at or before the end of each working day. Sediment shall be removed from the basin when it reaches the specified distance below the top of the riser. Sediment shall not enter adjacent streams or drainage ways during sediment removal or disposal. The sediment shall not be deposited downstream from the embankment, adjacent to a stream or floodplain.
9. Final Disposal: When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposits are to be leveled or otherwise disposed of in accordance with approved sediment control plan. The proposed use of a sediment basin site will often dictate final disposition of the basin and any sediment contained therein. If the site is scheduled for future construction, then the embankment and trapped sediment must be removed, safely disposed of, and backfilled with a structural fill. When the basin area is to remain open space, the pond may be pumped dry, graded and backfilled.

K Storm Drain Outlet Protection

1. Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan. Compact any fill required in the subgrade to the density of the surrounding undisturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.
2. The riprap and gravel filter must conform to the specified grading limits shown in the plans.
3. Geotextile must meet design requirements and be properly protected from punching or tearing during installation. Repair any damage by removing the riprap and placing another piece of filter fabric over the damaged area. All connecting joints should overlap a minimum of 1 ft. If the damage is extensive, replace the entire filter fabric.
4. Riprap may be placed by equipment, but take care to avoid damaging the filter.
5. The minimum thickness of the riprap should be 1.5 times the maximum stone diameter.
6. Construct the apron on zero grade with no overfall at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.

7. Ensure that the apron is properly aligned with the receiving stream and preferably straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of the apron.
8. Immediately after construction, stabilize all disturbed areas with vegetation.
9. Filter: Install a filter to prevent soil movement through the openings in the riprap. The filter should consist of a graded gravel layer or a synthetic filter cloth.
10. Maintenance: Inspect riprap outlet structures after heavy rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.

L Topsoiling

1. Testing: Field exploration should be made to determine whether the quantity and quality of surface soil justifies stripping.
2. Stripping: Stripping should be confined to the immediate construction area. A 4 to 6 inch stripping depth is common, but may vary depending on the particular soil.
3. Topsoil pH: If pH value is less than 6.0, lime shall be applied and incorporated with the topsoil to adjust the pH to 6.5 or higher.
4. Stockpiles: The location of topsoil stockpiles should not obstruct natural drainage or cause off-site environmental damage.
5. Stabilization: Stockpiles shall be contained by sediment barriers to prevent sedimentation on adjacent areas. Stockpiles shall be stabilized in accordance with specifications Temporary Mulching and Grassing or PAM that are contained within this specification
6. Liming: Soil tests should be used to determine the pH of the soil. Where the pH of the subsoil is 5.0 or less or composed of heavy clays, agricultural limestone shall be spread at the rate of 100 pounds per 1,000 square feet. Lime shall be distributed uniformly over designated areas and worked into the soil in conjunction with tillage operations.
7. Bonding: Use one of the following methods to insure bonding of topsoil and subsoil:
    a. Tilling: After the areas to be topsoiled have been brought to grade, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by discing or scarifying to a depth of at least 3 inches to permit bonding of the topsoil to the subsoil.
    b. Tracking: Passing a bulldozer over the entire surface area of the slope to leave horizontal depressions.
8. Applying Topsoil:
    a. Topsoil should be handled only when it is dry enough to work without damaging soil structure.
    b. A uniform application of 5 inches (unsettled) is recommended, but may be adjusted at the discretion of the Engineer.

M Temporary Mulching

1. When mulch is used without seeding, mulch shall be applied to provide full coverage of the exposed area. Mulch shall be applied as follows:
    a. Dry straw or hay mulch and wood chips shall be applied uniformly by hand or by mechanical equipment.

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b. If the area will eventually be covered with perennial vegetation, 20-30 pounds of nitrogen per acre in addition to the normal amount shall be applied to offset the uptake of nitrogen caused by the decomposition of the organic mulches.
c. Apply mulch binder on exposed areas, where indicated on the Drawings or as instructed by the Engineer.

2. Anchoring Mulch:
   a. Straw mulch can be pressed into the soil with a disk harrow with the disk set straight or with a special "packer disk." Disks may be smooth or serrated and should be 20 inches or more in diameter and 8 to 12 inches apart. The edges of the disk should be dull enough not to cut the mulch but to press it into the soil leaving much of it in an erect position.
   b. Straw mulch shall be anchored immediately after application.
   c. Straw mulch spread with special blower-type equipment may be anchored with Grade SS-1 emulsified asphalt in accordance with ASTM D977. The asphalt emulsion shall be sprayed onto the mulch as it is ejected from the machine. Use 100 gallons of emulsified asphalt and 100 gallons of water per ton of mulch.
   d. For Straw mulch, plastic mesh or netting with mesh no larger than one inch by one inch shall be installed according to manufacturer's specifications.
   e. Netting of the appropriate size shall be used to anchor wood waste. Openings of the netting shall not be larger than the average size of the wood waste chips.

N Temporary Grassing
1. Seed Bed Preparation:
   a. When a hydraulic seeder is used, seedbed preparation is not required.
   b. When using conventional or hand seeding, seedbed preparation is not required if the soil material is loose and not sealed by rainfall.
   c. When soil has been sealed by rainfall or consists of smooth cut slopes, the soil shall be pitted, trenched or otherwise scarified to provide a place for seed to lodge and germinate.
2. Select a grass or grass-legume mixture suitable to the area and season of the year.
3. Seed shall be applied uniformly by hand, cyclone seeder, drill, culti-packer- seeder, or hydraulic seeder (slurry including seed and fertilizer). Drill or cultipacker seeders should normally place seed one-quarter to one-half inch deep. Appropriate depth of planting is ten times the seed diameter.
4. Soil should be "raked" lightly to cover seed with soil if seeded by hand.
5. Irrigation: During times of drought, water shall be applied at a rate not causing runoff and erosion. The soil shall be thoroughly wetted to a depth that will insure germination of the seed. Subsequent applications should be made when needed.
6. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Temporary stabilization shall be provided to any area which will not receive permanent stabilization within the next 14 calendar days.

O Permanent Grassing & Sodding
1. Refer to specifications 32 92 19 Seeding and 32 92 23 Sodding for installation and maintenance.

2. Permanent Stabilization
   a. Permanent stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Permanent stabilization shall be provided to all areas of land disturbance within seven calendar days of the completion of land disturbance for any area greater than 0.25 acre.
   b. Grass or sod removed or damaged in residential areas shall be replanted with the same variety within seven calendar days of the completion of work in any area.
   c. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization. The {GT#156} shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.

3.3 CLEAN-UP

A Dispose of all excess erosion and sedimentation control materials in a manner satisfactory to the Engineer.

B All temporary erosion control measures shall be removed after final stabilization of the site has occurred, unless otherwise noted on the Drawings or instructed by the Engineer.

C Final clean-up shall be performed in accordance with the requirements of Section 01 74 23 of these Specifications.

END OF SECTION

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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, handling, manufacturers' standard warranties on products, special warranties and comparable products.

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, reused or repurposed 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 are equivalent 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" or "basis of design product" including make, 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, through the Construction Manager of approval

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or rejection of proposed comparable product request within business ten (10) days of receipt of request, or five (5) business 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 weather tight enclosure above ground, and with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment by covering construction.
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.

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7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location and security procedures 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 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:

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1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products 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 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 for Contractor's convenience will not be considered, unless otherwise indicated.
   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 for Contractor's convenience will not be considered, unless otherwise indicated.
   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.

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, and 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.

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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, Construction Managers, and Owners, if requested.
5. Samples, if requested.

PART 3 EXECUTION (NOT USED)

END OF SECTION 016000

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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. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Correction of the work.
   6. Coordination of Owner-installed products.
   7. Progress cleaning.
   8. Dust control.
   9. Starting and adjusting.
   10. 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 INFORMATIONAL SUBMITTALS

A. Qualification Data: For licensed land surveyor.

B. Certificates: Submit certificate signed by licensed land surveyor or certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 14 calendar days prior to the time cutting and patching will be performed. Include the following information:
   1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
   2. Changes to In-Place (Existing) Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
   3. Products: List products to be used for patching and firms or entities that will perform patching work.
   4. Dates: Indicate when cutting and patching will be performed.

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5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations prepared by Contractor's licensed Professional Engineer showing integration of reinforcement with original structure.
7. Describe cutting and patching procedures of lead based paint.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

E. Certified Surveys: Submit two copies signed by licensed land surveyor.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: 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 and load-deflection ratio. Structural elements include the following:
    a. Primary structural systems.
    b. Secondary and miscellaneous structural systems.
    c. Lintels.
    d. Bearing walls and retaining walls.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Mechanical systems piping and ducts.
    f. Control systems.
    g. Communication systems.
    h. Fire-detection and -alarm systems.
    i. Conveying systems.
    j. Electrical wiring systems.
    k. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in

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reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. 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.

D. 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.

B. In-Place (Existing) Materials: Use materials for patching identical to in-place (existing) materials. For exposed surfaces, use materials that visually match in-place (existing) adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place (existing) materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

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B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   1. Description of the Work.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
   4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions and the cost of any and all remedial work required due to installation on unacceptable surfaces and substrates or under improper conditions shall be borne by the Contractor.

E. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and/or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
   1. Refer to Section 011000 - Summary for utility interruptions.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 - Project Management and Coordination.

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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 Construction Manager promptly.

B. General: Engage a licensed 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 and Construction Manager 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 Construction Manager.

3.4 FIELD ENGINEERING

A. Identification: Refer to drawings for 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.

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2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

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.

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

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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. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 - Summary .

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. 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.

H. 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.

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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.

I. 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 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in this Specification Section.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces in kind.

3.8 PROGRESS CLEANING

A. General: Maintain and clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 calendar days during normal weather or three calendar days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
   5. Do not transport construction debris through occupied areas of existing facilities.

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B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Maintain and 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. Public Roads: Roads shall be cleared of all mud, dust, debris, etc. on a daily basis or as directed by Architect , Construction Manager, or Owner .

E. 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.

F. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

G. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

H. 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" or Section 017419 "Construction Waste Management and Disposal" .

I. 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.

J. 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.

K. 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.

L. Responsibilities of the Construction Manager and Contractor(s) :
   1. The Contractor shall provide and service dumpsters for the use of all Contractors.
   2. Dumpsters shall be located at each site, accessible to building and roads. Each Contractor may legally load acceptable construction debris into the Dumpsters from this project only. Cost of all disposal fees shall be by the Contractor and dumpsters shall remain on the project until project completion, or as directed by Owner. The Contractor shall secure dumpsters during off-hours. This excludes asbestos items.
   3. The Contractor is responsible for clean-up and disposal of waste materials, debris and rubbish on a daily basis.
   4. The Owner may issue written notification of insufficient cleaning relative to the requirements of this Section. Upon issuance of the cleaning notice:
      a. All waste and accumulation of trash containing the Contractor’s debris shall be removed from the Owner's premises within 24 hours of notification.
      b. All designated project areas containing the Contractor's debris or requiring general housekeeping shall be left fine broom clean (interior) or raked clean (exterior or

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rough surface). Sweeping compound shall be used for all interior broom cleaning to control dust.

c. Failure by the Contractor to comply with the 24 hour requirement of the notice to the satisfaction of the Owner will result in a cleaning program directed by the Owner at the expense of the Contractor. Cost of clean-up performed by the Owner will be deducted from the Contractor's Request for Payment.

5. Maintain areas under Contractor's control free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
6. Daily clean interior areas to provide suitable conditions for work.
7. Broom clean interior areas prior to start of surface finishing, and continue cleaning on an as-needed basis.
8. Control cleaning operations so that dust and other particles will not adhere to wet or newly-coated surfaces.
9. Remove waste materials, debris, and rubbish from site or to a dumpster provided by the Contractor daily.
10. The Contractor shall provide end-of-day clean-up of work areas of all prime contractors on a daily basis, conforming to requirements above.

3.9 DUST CONTROL

A. The Contractor shall at all times control the spread of dust and dirt during the execution of the work. Use water mist, temporary closures, and other suitable methods. Use wet saws for cutting. Provide walk-off mats at entrances and exits to construction areas.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions.
2. Wet mop floors to eliminate trackable dust and dirt and wipe down walls and doors of dust and dirt.

3.10 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.11 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.

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C. Supervise construction operations to ensure that in progress work is not stored on and/or effects completed construction such as floors and walls, which are subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

D. Roof Areas:
   1. Construction traffic and storage of materials of materials on completed roof surfaces is not allowed. Where work is required, the contractor shall submit a protection plan, 14 calendar days prior to scheduled commencement of the work. Protection plan to include the following: Type of work to be performed.
   2. Location of work areas.
   3. Route of materials and workers to work area.
   4. Materials and methods to be used.
   5. Proceed with work after Owners authorization. Damage to roof surfaces shall be repaired and the cost of any and all remedial work shall be borne by the Contractor.

END OF SECTION 017300

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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.

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.

C. Field Report: For pest control inspection.

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 10 business 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 Construction Manager. Label with manufacturer's name and model number where applicable.
      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   5. Submit test/adjust/balance records.
   6. Submit sustainable design submittals required in applicable individual "Sustainable" Section.
   7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 business days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
   6. Advise Owner of changeover in heat and other utilities.
   7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Complete final cleaning requirements, including touchup painting.
   10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 business days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Construction Manager will either proceed with

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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."
   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 business days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Construction Manager 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: Contractor shall prepare Punch List to include the following: 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.Use Wendel's standard Punch List format or Procore format
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. MS Excel electronic file. Architect, , will return annotated file.
      b. PDF electronic file. Architect, will return annotated file.

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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 business days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

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.

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:

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a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    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"

E. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner’s property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

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A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
      a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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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.

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.
   2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect, through Construction Manager, will return two copies.

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C. Initial Manual Submittal: Submit draft copy of each manual at least 30 business days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 business days before commencing demonstration and training. Architect will return copy with comments.
   1. Correct or revise each manual to comply with Architect comments. Submit copies of each corrected manual within 15 business days of receipt of Architect 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.

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4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager. (if applicable)
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority. (if applicable)
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.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.

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4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

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.
   8. Chemical release or spill.

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.
   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.

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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.

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.

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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.
   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.

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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. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. 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.

PART 3 EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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END OF SECTION 017823

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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.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one (1) set(s) of marked-up record prints.
   2. Number of Copies: Submit copies of Project Record Drawings as follows:
      a. Initial Submittal:
         1) Submit one (1) paper-copy set(s) of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and one (1) of file prints.
         3) Submit record digital data files and one (1) set(s) of plots.
         4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Re-submittal:
         1) Submit three (3) paper-copy set(s) of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and three (3) set(s) of prints.
         3) Print each drawing, whether or not changes and additional information were recorded.
      c. Final Submittal:
         1) Submit one (1) paper-copy set(s) of marked-up record prints.
         2) Submit record digital data files and three (3) set(s) of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy, INSERT # OF COPIES HERE, and annotated electronic PDF(s) and directories of Project's Specifications, including addenda and contract modifications.

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C. Record Product Data: Submit one paper copy, INSERT NUMBER OF COPIES HERE, and annotated electronic PDF(s) 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 one paper copy, INSERT NUMBER OF COPIES HERE, and annotated electronic PDF(s) and directories of each submittal.

E. Reports: Submit weekly 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, when such installation varies from that shown originally. Require individual person or entity who obtained record data, whether that individual or entity is an installer, subcontractor or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Clearly record and identify information about concealed elements that would be difficult to identify, measure or record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data immediately after revealing or obtaining it.
      d. Record and check the markup before enclosing or concealing installations.
      e. Cross-reference record prints to corresponding photographic documentation.
   2. Maintain on Project site at all times, in an approved location, and in a clean, dry and legible condition, one set of Project Drawings and one set of Submittals. These documents shall be used to record as-built conditions on a day-to-day basis, and shall be kept current and available for inspection by the Construction Manager during working hours.
   3. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Concealed insulation types, thicknesses and R-Values.
      c. Locations of discontinuous insulation, if any.
      d. Revisions to details shown on Drawings.
      e. Depths of foundations below first floor.
      f. Locations and depths of underground utilities.
      g. Revisions to routing of piping and conduits.
      h. Revisions to electrical circuitry.
      i. Actual equipment locations.
      j. Duct size and routing.
      k. Locations of concealed internal utilities.
      l. Changes made by Change Order or Construction Change Directive.
      m. Changes made following Architect's written orders.

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n. Details not on the original Contract Drawings.
o. Field records for variable and concealed conditions.
p. Actual installed information about Work that is otherwise shown only schematically.

4. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
5. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
6. Mark important additional information that was either shown schematically or omitted from original Drawings.
7. 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:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG: Autodesk AutoCAD, current version.
3. Format: RVT Autodesk Revit, current version.
4. Format: Annotated electronic PDF with comment function enabled.
5. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
6. Refer instances of uncertainty to Architect for resolution.
7. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
a. See Section 013300 Submittal Procedures for requirements related to use of Architect 's digital data files.
b. Architect will provide data file layer information. Record markups in separate layers.

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 electronic PDF, with comment function enabled.

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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:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS".
   d. Name of Architect and Construction Manager .
   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 particular 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, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy, annotated electronic PDF(s) and directories, or scanned electronic PDF(s) of marked-up paper copy of Specifications

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 particular 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 , record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy, annotated electronic PDF(s) and directories, or scanned electronic PDF(s) of marked-up paper copy of Specifications
   1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

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.

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B. Format: Submit miscellaneous record submittals as paper copy, annotated electronic PDF(s) and directories, or scanned electronic PDF(s) of marked-up miscellaneous record submittals .
   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 reference during normal working hours.

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

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 instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within ten business days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Construction Manager
      e. Name of Contractor.
      f. Date of video recording.
   2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet

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with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 - Quality Requirements, experienced in operation and maintenance procedures and training.

B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 - Project Management and Coordination. Review methods and procedures related to demonstration and training including, but not limited to, the following:
1. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
2. Review required content of instruction.
3. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.

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d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
   g. Include name and contact information for each equipment manufacturers installed products.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.

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d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:
a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 - Operation and Maintenance Data.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
1. Schedule training with Owner with at least fourteen calendar days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.

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1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
    a. Name of Contractor/Installer.
    b. Business address.
    c. Business phone number.
    d. Point of contact.
    e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
    a. Produce segments to present a single significant piece of equipment per segment.
    b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

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SECTION 024110 - SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition and removal of selected portions of building or structure.

B. Salvage of existing items to be reused or recycled.

1.2 RELATED REQUIREMENTS

A. Section 011000 - Summary - Use of premises and Ownerr-occupancy requirements.

B. Section 013233 - Photographic Documentation - Preconstruction photographs taken before selective demolition operations.

C. Section 015000 - Temporary Facilities and Controls - Temporary construction and environmental-protection measures for selective demolition operations.

D. Section 017300 - Execution - Cutting and patching procedures.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 REFERENCE STANDARDS

A. ANSI A10.6 - Safety and Health Program Requirements for Demolition Operations.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.5 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, period artifacts and equipment, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

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1. Coordinate with Owner's historical adviser, who will establish special procedures for removal and salvage.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of proposed dust- and noise-control temporary partitions and means of egress.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
6. Means of protection for items to remain and items in path of waste removal from building.

C. Predemolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Section 013233 - Photographic Documentation. Submit before Work begins.

D. Site Plan: Indicate:
1. Vegetation to be protected.
2. Areas for temporary construction and field offices.
3. Areas for temporary and permanent placement of removed materials.

E. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
2. Summary of safety procedures.

F. Qualification Data: For demolition firm.

G. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

H. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

I. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
1. Minimum of 10 years of documented experience.

B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

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C. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

E. Standards: Comply with ANSI A10.6 and NFPA 241.

F. Predemolition Conference: Conduct conference at Project site to comply with requirements in Section 013100 - Project Management and Coordination. Review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

1.8 PROJECT CONDITIONS

A. Owner will occupy portions of site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
   1. Comply with requirements specified in Section 011000 - Summary.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

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C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
1. Comply with requirements specified in Section 013233 - Photographic Documentation.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
1. Comply with requirements for existing services/systems interruptions specified in Section 011000 - Summary.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
    a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in Section 015000 - Temporary Facilities and Controls

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

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3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 - Temporary Facilities and Controls.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

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4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site as designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

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3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024110

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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 and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Description:
   1. This section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
      a. Footings.
      b. Foundation Walls.
      c. Site Retaining Walls.
      d. Slabs-On-Grade.
      e. Suspended Slabs.
      f. Concrete Toppings.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All cast-in-place concrete work on this project shall conform to the Construction Documents, applicable building code including referenced standards, the requirements of “Specification for Structural Concrete” ACI 301-16 (Chapters 1-5, & Chapters 6-14 as applicable) and "Specifications for Tolerances for Concrete Construction and Materials" ACI 117, in coordination with clarifications, exemptions, and additions in the Construction Documents.

C. Related Sections:
   1. Division 03 Specifications – Concrete Construction.
   2. Division 07 Specifications – Thermal and Moisture Protection.
   3. Division 31 Specifications – Earthwork.

1.3 SUBMITTALS

A. Design Mixtures:
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

B. Cold-Weather Placement: Submit detailed procedures for cold weather concreting in accordance with ACI 306.1.

C. Hot-Weather Placement: Submit detailed procedures for hot weather concreting in accordance with ACI 305.1.

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D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include 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.

E. Formwork layout and dimension shop drawings.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates

G. Material Certificates: For each of the following as applicable on the project, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

1.4 INFORMATION SUBMITTALS

A. Embed and Penetration Plans: Submit placing drawings that detail locations of mechanical, electrical, plumbing, and fire protection openings, sleeves and embedded accessories not specifically located on the Structural Construction Drawings, including routing of embedded conduit.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Comply with ACI 301.

B. Earth forms may be used for footing forms where sides of the excavation are cut true, in firm soil. If earth is not suitable to be used as “earth form,” no consideration will be given to any claim for additional cost of formwork. Contractor shall provide material and labor to provide formwork without additional cost to Owner.

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2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615 Grade 60 deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 Grade 60 deformed.
   1. For use where weldable reinforcing is called out in construction documents.

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

D. Headed Concrete Anchors: Conform to AWS D1.1 and ASTM A 108 specifications for 1010 through 1020 mild steels, type B. Minimum yield strength = 51,000 psi (0.2 % offset).

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Manufacture bar supports from plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete for use in foundations and slabs-on-grade only.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
      c. Use of supplemental cementitious materials may be rejected by Architect/Structural Engineer of Record for certain applications on project.
   2. Blended Hydraulic Cement: ASTM C 595, Type IS portland blast-furnace slag, Type IP portland-pozzolan, Type I (PM) pozzolan-modified Portland, Type I (SM) slag-modified portland cement. Use of blended hydraulic cement may be rejected by Architect/Structural Engineer of Record for certain applications on project.

B. Silica Fume: ASTM C 1240, amorphous silica. Use of blended hydraulic cement may be rejected by Architect/Structural Engineer of Record for certain applications on project.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Select grading class per type of construction or location used, and in relation to specific weathering region. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: See schedule on Construction Drawings.

D. Water: Shall be potable.

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.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.

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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 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820, deformed.
1. Products subject to compliance with requirements, provide the following:
a. Fiber: Type 1, Cold-Drawn Wire:
1) Insert manufacturer's name; product name or designation.
b. Fiber: Type 2, cut sheet:
1) Insert manufacturer's name; product name or designation.

B. Synthetic Micro-Fiber: polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III.
1. Products subject to compliance with requirements, provide the following:
a. Monofilament Fibers:
1) Insert manufacturer's name; product name or designation.
b. Fibrillated Fibers:
1) Insert manufacturer's name; product name or designation.

C. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III.
1. Products subject to compliance with requirements, provide the following:
a. Insert manufacturer's name; product name or designation.

D. Fiber reinforcement may be requested for substitution by contractor. Architect/Structural Engineer of Record shall review for compliance any substitution requested and approve or reject as necessary.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder meeting ASTM E 1745, minimum 10 mil thickness. Coordinate with Division 03 and 07 specifications and Architectural Drawings for additional requirements or increased thickness. See Construction Drawings for locations required. Install per qualified geotechnical engineer’s recommendation and ACI 302.1 requirements.

2.8 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 and ACI 318 chapter 5. Design mixtures shall meet the minimum requirements tabulated in the construction documents.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed. Requirements of table 4.1.2.9 of ACI 301 shall be adhered to.

C. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, plasticizing, or retarding admixtures in concrete, as required, for placement and workability, and project specific conditions.

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2.9 FABRICATING REINFORCEMENT

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

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete:
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 FORMWORK

A. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch for exposed smooth-formed finished surfaces.
2. Class B, 1/4 inch for exposed rough-formed finished surfaces.

3.2 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Field bending or straightening of reinforcing bars partially embedded in concrete is prohibited unless specifically permitted by Structural Engineer of Record. Comply with ACI 301 procedures for field bending and straightening.

C. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least two full panels. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.3 CONCRETE PLACEMENT

A. Do not add water to concrete during delivery or at Project site. Add water at project site only as noted on delivery ticket, and prior to beginning placement.

B. Cold-Weather Placement: Comply additionally with ACI 306.1 and as follows:
1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

C. Hot-Weather Placement: Comply additionally with ACI 305.1 and as follows:
1. 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.

3.4 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

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

C. Trowel Finish (after applying float finish):
1. Apply a trowel finish to surfaces 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.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

D. Trowel and Fine-Broom Finish:
1. Apply a trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
1. Coordinate required final finish with Architect before application.

3.5 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301, ACI 305, ACI 306, and ACI 306.1 as applicable.

B. Cure concrete according to ACI 308.1, by one or a combination of the methods allowed in ACI 301.

3.6 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect/Structural Engineer of Record. Remove and replace concrete that cannot be repaired and patched to Architect/Structural Engineer of Record approval.

B. 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 per ACI 301, to the satisfaction of the Architect/Structural Engineer of Record.

C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. For areas out of tolerance or specification, Contractor shall propose correction method to Architect/Structural Engineer of Record for approval.

3.7 FIELD QUALITY CONTROL

A. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

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1. Testing Frequency: Obtain at least one composite sample set for each 75 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 C 143; one test at point of delivery 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. Concrete Temperature: ASTM C 1064; 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.
4. Air Content: ASTM C231 or ASTM C173 as applicable, one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Compression Test Specimens: ASTM C 31.
   a. Cast and cure a minimum of four 6"x12" or five 4"x8" cylinder specimens for each composite sample.
   b. Additional cylinders to be cast for high-early strength concrete and as required for contractor's means and methods.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at 7 days and one set of two (6"x12")/three (4"x8") specimens at 28 days. Should 28 day strength not be met, test remaining cylinder at 56 days. Should 28 day strength be met, remaining cylinder may be discarded. Additional tests for high-early strength concrete and as required for contractor's means and methods.

B. Measure floor and slab flatness and levelness according to ASTM E 1155 as soon as possible but within 24 hours of finishing. Elevated framing shall be measured in its shored condition (where applicable).

END OF SECTION 033000

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SECTION 042613 - MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete block.

B. Clay facing brick.

C. Mortar.

D. Reinforcement and anchorage.

E. Flashings.

F. Installation of lintels.

G. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Loose steel lintels.

B. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.

D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

E. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units.

F. ASTM C129 - Standard Specification for Dry-Cast Nonloadbearing Concrete Masonry Units.

G. ASTM C150/C150M - Standard Specification for Portland Cement.

H. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.

I. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).

J. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

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K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.

L. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls.

M. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.

N. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.

C. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.

D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar and accessories and structural backup in mock-up.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.9 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

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B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Split-Face Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.
   a. Provide square-edged units for outside corners.
3. Non-Loadbearing Units: ASTM C129.
   a. Hollow block.
   b. Lightweight.

B. Standard Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
2. With integral water repellant.
3. Load-Bearing Units: ASTM C90, normal weight.
   a. Hollow block.
   b. Exposed Faces: Manufacturer's standard color and texture where indicated.

2.2 BRICK UNITS

A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
1. Color and texture to match existing.
2. Nominal Size: Modular.
3. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

B. Hydrated Lime: ASTM C207, Type S.

C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
1. Color(s): As indicated on drawings.
2. Manufacturers:
   a. Substitutions: See Section 016000 - Product Requirements.

D. Water: Clean and potable.

E. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
1. Substitutions: See Section 016000 - Product Requirements.

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2.4 REINFORCEMENT AND ANCHORAGE

A. Joint Reinforcement Type: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

B. Joint Reinforcement Standard: ASTM A951/A951M.
1. Type: Truss or ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
4. Manufacturers:
   a. Blok-Lok Limited: www.blok-lok.com/#sle.
   b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
   c. WIRE-BOND: www.wirebond.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
3. Vertical adjustment: Not less than 3-1/2 inches.
4. Manufacturers:
   a. Blok-Lok Limited: www.blok-lok.com/#sle.
   b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
   c. WIRE-BOND: www.wirebond.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

2.5 FLASHINGS

A. Metal Flashing Materials:
1. Prefabricated Metal Flashing: Smooth fabricated 12 oz/sq ft stainless steel (type 304) flashing for thru-wall conditions.
   a. Manufacturers:
      1) Hohmann & Barnard, Inc: www.h-b.com/#sle.
      2) WIRE-BOND: www.wirebond.com/#sle.
      3) Substitutions: See Section 016000 - Product Requirements.

2.6 ACCESSORIES

A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.
1. Manufacturers:
   a. Blok-Lok Limited: www.blok-lok.com/#sle.
   b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
   c. WIRE-BOND: www.wirebond.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

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B. Weeps:
   1. Type: Cotton cord.
   2. Manufacturers:
      a. All Gear, Inc: www.allgearinc.com.
      b. American Cord & Webbing: www.acw1.com.
      c. Substitutions: See Section 016000 - Product Requirements.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Panels installed at flashing locations.
      a. Manufacturers:
         1) CavClear, a Division of Archovations Inc; Masonry Mat: www.cavclear.com/#sle.
         2) Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
         3) Substitutions: See Section 016000 - Product Requirements.

D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.7 MORTAR MIXING

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
   1. Masonry below grade and in contact with earth; Type S.
   2. Exterior, non-loadbearing masonry; Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

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D. Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches.
   3. Mortar Joints: Concave.

3.3 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

3.4 WEEPS/CAVITY VENTS

A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.5 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.
   1. Verify that airspace width is no more than 3/8 inch greater than panel thickness.
   2. Hold cavity mortar control panel tight to face wythe.
   3. Install horizontally between joint reinforcement.
   4. Stagger end joints in adjacent rows.
   5. Fit to perimeter construction and penetrations without voids.

D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.6 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

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A. Install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.

E. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

F. Reinforce joint corners and intersections with strap anchors 16 inches on center.

3.7 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 1 inch, minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
   2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer’s directions.
   3. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
   4. Anchor vertical leg of flashing into backing with a termination bar and sealant.
   5. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.8 LINTELS

A. Install loose steel lintels over openings.

B. Maintain minimum 8 inch bearing on each side of opening.

3.9 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

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B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Size control joints as indicated on drawings; if not indicated, 3/8 inch wide and deep.

D. Form expansion joint as detailed on drawings.

3.10 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8 inch, plus 1/8 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.13 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 042613

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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 Specification Sections, apply to this section.

1.2 SUMMARY

A. Description:
   1. This section includes elements of the structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
   2. This section does not include Miscellaneous Metal Fabrications.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Structural Steel work on this project shall conform to the Construction Documents, applicable building code including referenced standards, and the requirements of AISC 360 “Specification for Structural Steel Buildings”, RCSC “Specification for Structural Joints Using High-Strength Bolts”, and AISC303 “Code of Standard Practice for Steel Buildings and Bridges” in coordination with clarifications, exemptions, and additions in the Construction Documents.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 09 Specification – Finishes

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172)..

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

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

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Shear stud connectors.

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4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Slide bearings.
8. Prefabricated building columns.
9. Shop primer.
10. Galvanized-steel primer.
11. Etching cleaner.
12. Galvanized repair paint.
13. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. 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 where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.
9. Delegated Design Submittal: For structural steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation who shall be licensed in the state of Georgia.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For qualified Installer and Fabricator.

B. Welding certificates.

C. Material (Mill) test reports for structural steel, including chemical and physical properties.

D. 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. Steel headed stud anchors (shear connectors/shear studs).
5. Shop primers.

E. Source quality-control reports.

F. Survey of existing conditions.

1.6 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 corrosion and deterioration.

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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 repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting fasteners after lubrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' 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. All Structural Steel not receiving fire-proofing shall receive one shop coat of rust-inhibitive primer. All steel with exterior exposure shall be painted with a double coat of rust prohibitive epoxy primer (material and thickness to be specified by Architect) unless noted as galvanized or architecturally exposed structural steel.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connection Design Information:
1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
2. Use Allowable Stress Design; data are given at service-load level.
3. Where beam shear is not noted, the connections shall develop the beam shear V = W/2 where W is the total allowable beam uniform load based on laterally supported simple span moments per tables located in the AISC Steel Construction Manual.

B. Moment Connections: Type FR, fully restrained.

C. Steel Frame Construction Type: As indicated in the Structural Construction Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. Provide Structural Steel materials meeting the standards and grades set forth in the Construction Drawings.

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2.3 BOLTS, CONNECTORS, AND ANCHOR RODS

A. Provide Bolts, Connectors, and Anchors of materials meeting the standards and grades set forth in the Construction Drawings.

2.4 SHRINKAGE-RESSISTANT GROUT

A. Provide shrinkage-resistant grout materials meeting the standards and grades set forth in the Construction Drawings.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
   4. Mark and match-mark materials for field assembly.
   5. 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/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermally cut, or punch holes perpendicular to steel surfaces. Do not free-hand thermally cut bolt holes or enlarge holes by burning.

D. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members only as indicated in Structural Construction Drawings.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not free-hand thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate 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.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High Strength Bolts" for type of bolt and type of joint specified in the Construction Drawings.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

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2.7 PRIMER PAINT

A. Fabricator's standard rust-inhibiting grey primer. Do not prime steel that is to receive fire-proofing spray. Provide finish where indicated on Construction Drawings (see Architectural Drawings and Division 09 specifications).

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to Structural Steel according to ASTM A123.
   1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles, any framing exposed to earth or weather, and other framing as indicated in the Construction Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with Steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of 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, bracing, and diaphragms are in place unless otherwise indicated.

3.3 ERECTION

A. Set Structural Steel accurately in locations and to elevations indicated and in accordance with AISC 303 and AISC 360.

B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of base plate where indicated in Structural Construction Drawings.
   3. 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 plate before packing with grout.
   4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

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C. Maintain erection tolerances of Structural Steel within AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form 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. Slope roof framing members to slopes indicated on Construction Drawings.
   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. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. 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.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified in the Construction Drawings.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: 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.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

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SECTION 052100 - STEEL JOIST FRAMING

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. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Steel joist accessories.
5.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:
1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

C. Delegated design submittal: For steel joists indicated to comply with performance requirements and design criteria, comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for their preparation who shall be licensed in the state of Georgia.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

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C. Manufacturer certificates.

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

E. Mill Certificates: For each type of bolt.

F. Field quality-control and special inspection reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications", and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."
   1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications," and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on the Structural Construction Drawings.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Floor Joists: Vertical deflection of 1/360 of the span.
      b. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: As indicated on the Structural Construction Drawings.

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2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
3. Provide holes in chord members for connecting and securing other construction to joists.
4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
6. Camber joists according to SJI's "Specifications," unless otherwise indicated on the Structural Construction Drawings.
7. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on the Structural Construction Drawings.
1. Provide holes in chord members for connecting and securing other construction to joists.
2. Camber long-span steel joists according to SJI's "Specifications," unless otherwise indicated on the Structural Construction Drawings.
3. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

A. Primer:
1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Comply with additional requirements in Division 09 Specifications.

2.4 STEEL JOIST ACCESSORIES

A. Bridging:
1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. High-Strength Bolts, Nuts, and Washers: as indicated on the Structural Construction Drawings.
1. Finish: as indicated on the Structural Construction Drawings.

C. Welding Electrodes: Comply with AWS standards.

D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

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C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

D. Comply with additional shop priming requirements specified in Division 09 Specifications for joists and joist accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions, where specified, to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework where indicated. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts where indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting:
1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

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a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
b. Apply a compatible primer of same type as primer used on adjacent surfaces.

2. Comply with additional cleaning and touchup painting requirements specified in Division 09 Specifications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: A qualified special inspector shall perform the applicable special inspections indicated in the Construction Documents.

B. Testing Agency: A qualified testing agency shall perform tests and inspections.

END OF SECTION 052100

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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. Description:
   1. This section includes Roof Deck and Composite Floor Deck.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Steel Deck work on this project shall conform to the Construction Documents, applicable building code including referenced standards, and the requirements of Steel Deck Institute's (SDI) "Standard Specification" and "Code of Standard Practice."

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 09 Specification – Finishes

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

B. 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."

1.4 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated on Construction Drawings and/or Shop Drawings.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 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.

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PART 2 - PRODUCTS

2.1 ROOF DECK

A. Steel 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. Coordinate additional requirements with Construction Drawing General Notes and plan notes.

2.2 COMPOSITE FLOOR DECK

A. Composite Steel 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. Coordinate additional requirements with Construction Drawing General Notes and plan notes.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Self-drilling tapping screws that are in compliance with ASTM C1513 and that have been tested in accordance with AISI standards S904 and S905.

C. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of same material and finish as deck; of profile indicated or required for application.

D. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.

E. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Flat Sump Plate: Single-piece steel sheet of same material and finish as deck. For drains, cut holes in the field.

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.

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3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install deck with corrugations running perpendicular to supports. Deck sheet shall be supported by a minimum of four supports (three span condition).

3.3 ROOF-DECK INSTALLATION

A. Miscellaneous Roof-Deck Accessories: Install roof sump pans, sump plates, ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions.
   1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.4 FLOOR-DECK INSTALLATION

A. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

B. 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.

3.5 REPAIRS AND 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.

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

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SECTION 054000 - COLD-FORMED 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 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall framing
   2. Ceiling joist framing.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Cold-Formed Steel Framing work on this project shall confirm to the Construction Documents, applicable building code including referenced standards, and the requirements of AISI S100 “North American Specification for the Design of Cold-formed Steel Structural Members”, AISI S240 “North American Standard for Cold-formed Steel Structural Framing”, and AISI S202 “Code of Standard Practice for Cold-formed Steel Structural Framing” in coordination with clarifications, exemptions, and additions in the Construction Documents.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.

1.3 QUALITY ASSURANCE

A. Framing members shall be manufactured and supplied by one manufacturer and be of the type and size as indicated on Construction Drawings and/or Shop Drawings.

B. 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.

C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code–Steel,” and AWS D1.3, “Structural Welding Code–Sheet Steel.”

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory indicated.

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B. Shop Drawings: Submit Shop Drawings showing fabrication and erection procedures. Shop Drawing (if indicated as a requirement by this specification) shall bear the seal of a registered design professional licensed in the state in which the project is located.
   1. Show locations, sizes, gauges, spacing and types of framing composites, details of connections and framing of windows, doors and punched openings.
   2. Indicate all prefabricated framing with individual panels shown for each condition. Indicate member properties, details of connections, all erection and permanent bracing required.
   3. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for installation.
   4. Shop Drawings shall indicate sequence and method of erection details of all connection of cold-formed steel framing to other elements of the building structure.
   5. Indicate shop and field assembly details, including cut and connections.
   6. Indicate type and location of welds, bolts, and fastening devices.

C. Delegated-Design Submittal: For work indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the registered design professional responsible for their preparation who shall be licensed in the state of Georgia.

D. Structural design calculations: Indicate compliance with specified design criteria. Calculations shall bear the seal of a registered design professional licensed in the state in which the project is located.

1.5 INFORMATION SUBMITTALS

A. Welding certificates.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed steel framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed steel framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Clark Dietrich Building Systems
   2. Marino\Ware
   3. Cemco Steel

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Employ a qualified design professional, licensed in the state in which the project is located, to perform design and prepare signed and sealed Shop Drawings and

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Calculations for submittal. Comply with design intent, criteria, and requirements of the Construction Documents.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated in the Construction Documents.
   1. Design Loads: As indicated in the Construction Documents.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Wall Framing: Horizontal deflection of L/600 for brick/stone veneer, L/360 for simulated stone walls or stucco finish and L/240 for EIFS or other flexible finishes.
      b. Ceiling Joist Framing: Vertical deflection of 1/360of the span.
   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 indicated in the Construction Documents.
   4. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. In addition to design loads all cold-formed members shall be sized for the connection requirements of the cladding and/or framing which attaches to them, including but not limited to sheathing, paneling, doors, windows, louvers, minor canopies, and sun shades.

D. Existing Conditions: Inspect structure for compliance with specified erection tolerances.

E. Design and coordinate installation and location of anchors and inserts with structural system to which cold-formed steel framing is attached.

2.3 MATERIALS

A. Steel Sheet: ASTM A1003, Structural Grade, Type H, minimum 20 gauge, metallic coated, of grade and coating designation as follows:
   1. Grade:
      a. ST33H for 33 mil and 43 mil
      b. ST50H for 54 mil, 68 mil, and 97 mil
   2. Coating:
      a. G60.

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: Not less than coating of connected element.

2.4 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: 0.0428 inch.
   2. Flange Width: 1-3/8 inches.

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B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes and tracks used to form header beams, of web depths indicated or as required by design, unpunched, with stiffened flanges.

D. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

E. 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.

F. 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 loads and transfer them to the primary structure.
   2. Inner Track: Of web depth indicated.

G. 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.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel joists, unpunched and without splices.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   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.

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2.7 ANCHORS, CLIPS, AND FASTENERS

A. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. 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.

C. Welding Electrodes: Comply with AWS standards.

2.8 FABRICATION

A. Fabricate cold-formed steel 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 steel framing members by welding or screw fastening, 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 steel framing by welding, bolting, or screw fastening, according to Shop Drawings and manufacturer’s requirements.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that 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 1/4 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel 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 in AISI S202 and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S202, and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel 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 steel 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 steel 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. Handling and lifting of prefabricated panels or assemblies shall be done in a manner as to not cause distortion or damage in any member, or damage to any connection.

H. Loads placed on panels or assemblies during erection shall not exceed design loads.

I. Do not bridge building expansion and control joints with cold-formed steel framing. Independently frame both sides of joints.

J. If required, install insulation, specified in Division 07, 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.

K. Erection Tolerances: Install cold-formed steel framing level, plumb, and true-to-line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

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1. Space individual framing members no more than plus or minus 1/4 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacing as follows:
   1. Anchor Spacing: As required by design, but not to exceed 24 inches max, and within 3 inches of ends.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Stud Spacing: As indicated or as required by design.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated or required by design.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
   2. Install runner tracks, jack studs, and cripple studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically at 48 inches. Decrease spacing as required by design. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
   2. Strap 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.

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3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated or as required by design.
1. Anchor Spacing: As required by design, but not to exceed 24 inches max, and within 3 inches of ends.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/4 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:
1. Stud Spacing: As indicated or as required by design.

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. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. In high seismic areas connect drift clips to cold formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Decrease spacing as required by design. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap 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. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track, or install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
1. Install solid blocking at 96-inch centers.

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G. 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.

3.6 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
1. Install joists over supporting frame with required end bearing.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:
1. Joist Spacing: as indicated or as required by design.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals as indicated or as required by design. Fasten bridging at each joist intersection as follows:
1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel 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 steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

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. Description:
   1. This section includes items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Metal Fabrication work on this project shall confirm to the Construction Documents and applicable building code including referenced standards.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 09 Specification – Finishes

1.3 QUALITY ASSURANCE

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

B. Field Measurements: Verify actual locations of walls and other construction contiguous with Metal Fabrications by field measurements before fabrication.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for Metal Fabrications.
   1. Include plans, elevations, sections, and details of Metal Fabrications and their connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.1 GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For Metal Fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

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2.2 METAL MATERIALS

A. Provide Structural Steel materials meeting the standards and grades set forth in the Construction Drawings.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. Provide Bolts, Connectors, and Anchors materials meeting the standards and grades set forth in the Construction Drawings.

2.4 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

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2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Galvanize miscellaneous framing and supports where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe or as indicated in Architectural Drawings.
   1. Cap bollards with 1/4-inch thick steel plate when not filled with concrete.
   2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
   3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
   4. See Architectural Drawings for requirements.

B. Coordinate bollard attachment (base plate or embedment) with Architectural Drawings.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize loose steel lintels located in exterior walls.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

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Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete where indicated on Architectural Drawings.

B. Anchor bollards as indicated in Architectural Drawings.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

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SECTION 061000 - ROUGH CARPENTRY - STRUCTURAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Description:
   1. This section includes framing with dimension lumber, framing with timber, framing with engineered wood products, wood blocking, and nailers.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Rough Carpentry work on this project shall confirm to the Construction Documents and applicable building code including referenced standards.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 09 Specification – Finishes

1.3 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

B. Grade Marks: Identify all lumber and plywood by official grade marks.
   1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable, and condition of seasoning at time of manufacture.
   2. Softwood Plywood: Appropriate grade trademark of the American Plywood Association indicating:
      a. Type, grade, class and identification index.
      b. Inspection and testing agency mark.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

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3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to the job site, place materials in areas protected from weather.

B. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

C. Store TJI joists in a vertical position.

D. Store materials a minimum of 6” above ground on blocking and cover with protected waterproof covering, providing for adequate air circulation and ventilation.

E. Do not store seasoned materials in wet or damp portions of building.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1
1. Preservative Chemicals: Acceptable to authorities having jurisdiction.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

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1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Construction Drawings.

2.3 DIMENSION LUMBER FRAMING

A. Dimensions: Indicated lumber dimensions are nominal. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and all the rules writing agencies.

B. Maximum Moisture Content shall be as noted in the Construction Drawings.

C. Non-Load-Bearing Interior Partitions shall be of a grade, species, and modulus of elasticity noted in the Construction Drawings.

D. Exterior and Load-Bearing Walls shall be of a grade, species, and modulus of elasticity in the Construction Drawings.

E. Joists, Rafters, and Other Framing Not Listed Above shall be of a grade, species, and modulus of elasticity noted in the Construction Drawings.

F. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
1. Species and Grade: As indicated above for load-bearing construction of same type.

2.4 TIMBER FRAMING

A. Timber framing shall be off a dimension, grade, species, and modulus of elasticity noted in the Construction Drawings.

2.5 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer(s) noted in the Construction Drawings.
2. Laminated-Veneer Lumber shall be of an allowable stress and modulus of elasticity noted in the Construction Drawings.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.

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B. Dimensions: Indicated lumber dimensions are nominal. Actual dimensions conform to industry standards established by the American Lumber Standards Committee and all the rules writing agencies.

C. Maximum Moisture Content shall be as noted in the Construction Drawings.

D. Miscellaneous Lumber shall be off a grade, species, and modulus of elasticity noted in the Construction Drawings.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated in Construction Drawings that comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Post-Installed Anchors: All expansion, screw, and adhesive anchors shall be as noted in the Construction Drawings.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer(s) noted in the Construction Drawings.

B. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Construction Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions.

D. Do not splice structural members between supports, unless otherwise indicated.

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E. Provide blocking and framing as indicated in Construction Drawings and as required to support facing materials, fixtures, specialty items, and trim.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated in Construction Drawings, complying with the following:
1. NES NER-272 for power-driven fasteners.
2. Governing Model Code with relevant Addenda, referenced in Construction Drawings, and all related and referenced Standards.

I. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction, unless otherwise indicated.
1. Overlap double top plate minimum of 6” at corners and intersections, as follows.
2. Toenail studs to bottom plate and end-nail to lower top plate.

B. Provide studs in continuous lengths without splices.
1. Provide studs of a size and spacing as designated in the Construction Drawings.

C. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions, where sheathing is not present in finished construction.

D. Construct corners and intersections with three or more studs, where not explicitly noted or scheduled in Construction Drawings.

E. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

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1. Provide king studs, jamb studs, and headers as noted in Construction Drawings.

3.4 JOIST AND RAFTER FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as noted in the Construction Drawings.

B. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.

C. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together by toe nailing or metal connectors. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

D. Provide solid blocking between joists under jamb studs for openings.

E. Provide bridging at intervals of 96 inches o.c., between joists.

F. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
   1. At valleys, bevel ends of jack rafters for full bearing against valley rafters. Where not specifically noted otherwise in Construction Drawings, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper.
   2. At hips, bevel ends of jack rafters for full bearing against hip rafter. Where not specifically noted otherwise in Construction Drawings, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper.

END OF SECTION 061000

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SECTION 061001 - ROUGH CARPENTRY - ARCHITECTURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass Mat Faced Gypsum Sheathing.

B. Concealed wood blocking, nailers, and supports.

1.2 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Steel Framing

B. Section 061000 - Rough Carpentry - Structural - Structural Sheathing.

C. Section 072700 - Air Barriers: Air barrier over sheathing.

D. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

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

F. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

G. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products.

H. AWPA U1 - Use Category System: User Specification for Treated Wood.

I. ICC (IBC) - International Building Code.

J. ITS (DIR) - Directory of Listed Products.

K. PS 1 - Structural Plywood.

L. PS 20 - American Softwood Lumber Standard.

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M. UL (DIR) - Online Certifications Directory.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide technical data for each type of process and factory-fabricated product; wood preservative materials, application instructions, and fire-retardant treatments.

C. Product Data: Submit technical data on wood treatment.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 CONSTRUCTION PANELS

A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.

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1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
2. Edges: Square.
3. Products:
   a. CertainTeed Corporation; GlasRoc Brand: www.certainteed.com/#sle.
   b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
   d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode USGX 5/8 in. (15.9 mm): www.usg.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.

B. See Section 061600 Wood Sheathing for structural sheathing at corners and other locations indicated on the drawings.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.3 FIRE-RETARDANT TREATMENT (FRT)

A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.

B. Kiln-dry after treatment (KDAT) to maximum moisture content of 19 percent for sawn material and 15 percent for plywood.

C. Fabrication of FRT Wood:
1. Ripping or milling of boards, lumber, and timber after treatment is not permitted.
2. Field cutting to length and drilling of holes in boards, lumber, and timber are permitted without additional treatment.
3. Field cutting and drilling of holes in plywood are permitted.

D. Label or brand FRT wood with classification mark of UL (DIR) or ITS (DIR) or other approved inspection agency, the treatment plant, name of treatment, species of wood, flame spread and smoke developed index, method of drying after treatment, and treating standard.

2.4 PRESSURE-PRESERVATIVE TREATMENT (PPT)

A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.

B. Applications - Treat the Following:
1. Sleepers and sills on concrete or masonry in direct contact with earth: .
2. Wood framing members in direct contact with interior of exterior masonry or concrete walls below grade: Use Category _____.
3. Lumber and plywood in contact with membrane roofing and flashing: .
4. Lumber and plywood in contact with waterproofing and flashing: Use Category _____.

C. Kiln-dry wood after treatment with waterborne preservative to maximum moisture content of 19 percent for lumber and 15 percent for plywood.

D. Fabricate to maximum extent possible before treatment.

E. Label preservative-treated wood with marking as required by AWPA U1 and ICC (IBC). Unless otherwise permitted by standard U1 and building code, include the following markings: AWPA U1, accredited inspection agency mark, treating plant identification, type of preservative, preservative retention, and permitted end use.

F. Field Treatment for Cuts and Holes in Preservative-Treated Wood: Comply with AWPA M4.

2.5 ACCESSORIES

A. Metal and Finish of Fasteners:
   1. Fire-Retardant-Treated Wood:
      a. Nails, timber rivets, wood screws, and lag screws: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
   2. Preservative-Treated Wood:
      a. Nails, timber rivets, wood screws, and lag screws - general use: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
   3. Untreated Wood: Unfinished steel.

B. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Nails, Brads, and Staples: ASTM F1667/F1667M.

C. Sill Flashing: See Section 076200.

D. General Purpose Construction Adhesives: Comply with ASTM C557.

E. Air Barrier: See Section 072700.

PART 3 EXECUTION

3.1 PREPARATION

A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

B. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.3 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

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B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide nonstructural framing and blocking to support the following:
1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.
8. Joints of rigid wall coverings that occur between studs.
9. Other wall- or ceiling-mounted items indicated on drawings.

3.4 INSTALLATION OF CONSTRUCTION PANELS

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

D. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

G. Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

H. Space panels 1/8 inch apart at edges and ends.

I. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.

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J. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. See Section 061600 Wood Sheathing for structural sheathing at corners and other locations indicated on the drawings.
   2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

K. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.5 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Air barriers will be considered defective if they do not pass tests and inspections.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING

A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

3.8 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061001

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SECTION 061600 - WOOD SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Description:
   1. This section includes wall, floor, and roof sheathing.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Rough Carpentry work on this project shall confirm to the Construction Documents and applicable building code including referenced standards.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 06 Specification – Wood.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to the job site, place materials in areas protected from weather.

B. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

C. Store materials a minimum of 6” above ground on blocking and cover with protected waterproof covering, providing for adequate air circulation and ventilation.

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D. Do not store seasoned materials in wet or damp portions of building.

E. Protect sheet materials from breaking corners and damaging surfaces.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As noted in the Construction Drawings

D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Construction Drawings.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA U1

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Where denoted on Construction Drawings, provide pigmented wood treatment for visual recognition of Fire-Retardant-Treated materials.
   2. For exposed sheathing indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency, or use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

C. Application: Treat items indicated on Construction Drawings

2.4 WALL SHEATHING

A. Oriented-Strand-Board Wall Sheathing shall be of a grade, species, and modulus of elasticity noted in the Construction Drawings
   1. Type and Thickness shall be as indicated in the Construction Drawings.
   2. Coordinate with Division 09 specifications.

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2.5 ROOF SHEATHING

A. Plywood Roof Sheathing shall be of a grade, species, and modulus of elasticity noted in the Construction Drawings.

B. Oriented-Strand-Board Roof Sheathing shall be of a grade, species, and modulus of elasticity noted in the Construction Drawings

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Provide G90 hot-dipped galvanized steel or Type 304 stainless steel for components for all non-pressure treated and fire-retardant treated sheathing except nails shall be hot-dipped galvanized.
   2. Material and finish for use with pressure preservative treated components or exposed to weather shall be G185 hot-dipped galvanized steel or Type 316L stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Steel Framing: shall be coordinated with Division 05 specifications.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Steel Framing: shall be coordinated with Division 05 specifications.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated on Construction Drawings, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Governing Model Code with relevant Addenda, referenced in Construction Drawings, and all related and referenced Standards.

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

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E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated in the Construction Drawings:
   1. Allow 1/8” between end joints and 1/4” between edge joints for expansion and contraction.
   2. Provide sheathing clips at midspan of roof sheathing.

3.3 GYPSUM SHEATHING INSTALLATION

A. See section 061001 – Rough Carpentry - Architectural

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

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. Description:
   1. This section includes wood roof trusses, wood floor trusses, wood girder trusses, wood truss bracing, metal truss accessories.

B. Related Documents and Standards:
   1. All referenced standards and cited publications shall be those specifically denoted within the applicable building code noted in the General Notes of the Construction Drawings.
   2. All Rough Carpentry work on this project shall confirm to the Construction Documents and applicable building code including referenced standards.

C. Related Sections:
   1. Division 05 Specifications – Steel Construction.
   2. Division 06 Specifications - Wood

1.3 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
   1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Grade Marks: Identify all lumber and plywood by official grade marks.
   1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable, and condition of seasoning at time of manufacture.

D. Source Limitations for Connector Plates: Obtain metal connector plates from a single manufacturer.

E. Comply with applicable requirements and recommendations of the following publications:
   1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."

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2. SBCA/TPI BCSI-B1 "guide for handling, installing, restraining and bracing of trusses."
3. SBCA/TPI BCSI-B7 "guide for handling, installing, & bracing of 3x2 & 4x2 parallel chord trusses."
4. SBCA/TPI BCSI-B3 "permanent restraint/bracing for trusses."

F. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

1.4 SUBMITTALS

A. Product Data: For wood-preservative-treated lumber, fire-retardant treated lumber, metal-plate connectors, metal truss accessories, and fasteners.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer. Show fabrication and installation details for trusses. Shop drawings shall be sealed and signed by a Registered Design Professional licensed in the state in which the project is located.
1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
5. Show splice details and bearing details.
6. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
7. Fabrication of trusses before shop drawings have been approved by the Architect is prohibited.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with all recommendations of SBCA/TPI BCSI-B1 "guide for handling, installing, restraining and bracing of trusses."
1. Deliver trusses to Project site banded in “sets”. Unload to storage area using slings and lifting devices at indicated lift points. Trusses off-loaded from trucks or trailers by “dumping” or “rolling” shall be immediately rejected, marked, and removed from the Project site.
2. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
3. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
4. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

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1.6 COORDINATION

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

1.7 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
   1. Design Loads: As indicated on Construction Drawings.
   2. Maximum Deflection Under Design Loads:
      a. Roof Trusses: Vertical deflection as indicated on Construction Drawings.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

A. See Rough Carpentry Specification in Division 06 – Wood.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. See Rough Carpentry Specification in Division 06 – Wood.

2.3 METAL CONNECTOR PLATES

A. General: Fabricate connector plates to comply with TPI 1.

2.4 FASTENERS

A. See Rough Carpentry Specification in Division 06 – Wood.

2.5 METAL TRUSS ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer(s) noted in the Construction Drawings.

B. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Construction Drawings.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.7 FABRICATION

A. Fabricate trusses in accord with approved shop drawings and design computations.

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B. Fabricate trusses in permanent facility devoted principally to truss fabrication.

C. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

D. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

E. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1.
   1. Position members to produce design camber indicated.
   2. Fabricate wood trusses within manufacturing tolerances in TPI 1.

F. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press. If truss is removed from jig to apply plate to reverse side, care shall be taken to prevent opening of joint.

G. Each truss shall carry permanently affixed stamp of fabricator, indicating truss identification number with reference to shop and setting drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to SBCA/TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses as indicated in Shop Drawings, per requirements indicated in Construction Drawings, and no further than 24 inches o.c. Adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as indicated in Construction Drawings. Install fasteners through each fastener hole in truss accessories according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.
   1. Anchor trusses to girder trusses as indicated in Construction Drawings.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
   1. Install bracing to comply with SBCA/TPI BCSI requirements.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not cut or remove truss members.

L. Restrict construction loads on roof and floor surfaces to prevent over-stressing of truss members.

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M. Replace wood trusses that are damaged or do not meet requirements.
   1. Do not alter trusses in field.

3.2 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 061753

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SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

C. Factory finishing.

D. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Support framing, grounds, and concealed blocking.

B. Section 123600 - Countertops.

1.3 REFERENCE STANDARDS

A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.

D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.

C. Product Data: Provide data for hardware accessories.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.6 MOCK-UPS

A. Provide mock-up of typical base cabinet, including hardware and finishes.

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B. Locate where directed.

C. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.8 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:
1. Finish - Exposed Exterior Surfaces: Decorative laminate.
2. Finish - Exposed Interior Surfaces: Decorative laminate.
3. Finish - Semi-Exposed Surfaces: Decorative laminate
4. Finish - Concealed Surfaces: Manufacturer's option.
5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
6. Casework Construction Type: Type A - Frameless.
7. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
8. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
   a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
9. Adjustable Shelf Loading: 40 psf.
   a. Deflection: L/144.
10. Cabinet Doors and Drawer Fronts: Flush style.
11. Drawer Side Construction: Multiple-dovetailed.

2.2 WOOD-BASED COMPONENTS

A. Dimensional Lumber: Utilize pressure-treated wood at locations in contact with the floor.

2.3 PANEL CORE MATERIALS

A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
1. For cabinet doors and drawer fronts only.

2.4 HARDWOOD PLYWOOD PANELS

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A. Hardwood Plywood: Plywood manufactured for nonstructural decorative applications; consisting of faces and backs applied to a variety of core types; comply with HPVA HP-1.
   1. For all cabinet components not specifically identified as MDF or dimensional lumber.

2.5 LAMINATE MATERIALS

A. Manufacturers:
   1. Basis of Design: Formica Corporation: www.formica.com.
   2. Panolam Industries International, Inc: www.panolam.com.
   3. Wilsonart LLC: www.wilsonart.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Provide specific types as follows:
   1. Plastic Laminate PL-1: Horizontal Surfaces, Vertical Surfaces; Grade 12 HGP, 0.039 inch nominal thickness, natural grain finish.
   2. Plastic Laminate PL-2: Cabinet and Drawer Interior Surfaces; Grade 12 HGP, 0.039 inch nominal thickness, satin finish.

2.6 COUNTERTOPS

A. Countertops: See Section 123600.

2.7 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

2.8 HARDWARE

A. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, satin finish, for nominal 1 inch spacing adjustments.
   1. Basis of Design: Knape & Vogt Manufacturing Company; 255 Series Aluminum Standards: www.knapeandvogt.com.

B. Drawer and Door Pulls: bar drawer/door pull; satin stainless steel finish; 7 inch centers.
   1. Basis of Design: Basis of Design: Kohler Co.; "Purist" #K-25499; www.kohler.com.

C. Drawer Slides:
   1. Type: Full extension.
   2. Static Load Capacity: Extra Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.
   6. Manufacturers:

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a. Basis of Design: Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides #8500: www.knapeandvogt.com.
b. Substitutions: See Section 016000 - Product Requirements.

D. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
1. Manufacturers:
a. Basis of Design: Blum, Inc; CLIP top BLUMOTION: www.blum.com.

E. Grommets: 3" hole desk grommet, satin chrome (26D) finish.
1. Basis of Design: Doug Mockett and Company, Inc.; XG Flip Top Series, www.mockett.com

2.9 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Provide edging on all sides of shelves. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

3.3 ADJUSTING

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A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 064100

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SECTION 064201 - ACOUSTIC SIMULATED WOOD WALL AND CEILING PANELING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Custom acoustic simulated wood wall and ceiling paneling system.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Grounds and concealed blocking.

B. Section 099123 - Interior Painting: Painting adjacent surfaces.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard.

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

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data materials and application instructions.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide plan of panel number sequencing.

D. Samples: Submit two samples of simulated wood panel system 24 x 24 inch in size.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Single Source Responsibility: Provide and install this work from single manufacturer.

1.6 MOCK-UP

A. Construct mock-up, 8 feet long by 8 feet wide, illustrating full panel sheet,

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

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A. Protect work from moisture damage.

B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Comply with applicable codes for fire-retardant requirements incuding ASTM E84.

2.2 ACOUSTIC SIMULATED WOOD PANELS

A. Manufacturer:
1. Basis of Design: EzoBord: www.ezobord.com.
2. Substitutions: Section 016000 - Product Requirements.

B. Products:
1. Basis of Design: EzoBord Balsa Acoustic Slat Wood Wall Panels
   a. Slat Size: 2 inch wide x 6 inch deep.
   b. Slat Spacing: 4 inch between slats.
   c. Slat Finish: EzoPrint wood print to coordinate with Formica 8908 "Storm Teakwood."
   d. Backer Panel: 9mm.
      1) Color: Black.
   e. Slats designed to be pressure-fit and to be scrwed in place under removable slat.
   f. Slats of wall and ceiling panels to be aligned.

2.3 WOOD-BASED MATERIALS - BACKER PANEL

A. Particleboard: Composed of wood chips, medium density, with waterproof resin binders; of grade to suit application; sanded faces; complying with ANSI A208.1.

2.4 ADHESIVES AND FASTENERS

A. Adhesives: Approved by the manufacturer and type suitable for intended purpose.

B. Fasteners: Of size and type to suit application; install in concealed locations.

2.5 FABRICATION

A. Shop prepare and identify panels for site erection.

B. Prepare panels for delivery to site, permitting passage through building openings.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting and scribing.

2.6 SHOP FINISHING

ALPHA SPEC SET 09-10-2026

A. Sand work smooth.

2.7 ACCESSORIES

A. Lumber for Shimming, Blocking: Softwood lumber of any species.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify adequacy of backing and support framing.

C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Do not begin installation until materials have been fully acclimated to interior conditions.

B. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.

C. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.

D. Install with hairline cracks between wall and ceiling members

E. Coordinate the installation of firestopping behind paneling.

F. Touch up damaged finish to match original, using materials provided by fabricator; replace components that cannot be refinished like new.

3.3 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION 064201

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SECTION 072100 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Batt insulation in exterior wall construction.

B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

C. Rigid insulation as part of the exterior wall assembly.

1.2 RELATED REQUIREMENTS

A. Section 072600 - Vapor Retarders: Separate vapor retarder materials.

B. Section 072700 - Air Barriers: Separate air barrier materials.

C. Section 074113 - Metal Roof Panels

1.3 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
   1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
   2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
   3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.4 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

D. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

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

G. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

H. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.6 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.7 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Over Metal Stud Framed Walls, Continuous: Polyisocyanurate board.

B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

C. Insulation over Roof Deck: Polyisocyanurate board.

2.2 FOAM BOARD INSULATION MATERIALS

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
         1) Class 2 - Glass fiber reinforced or non-reinforced core foam.
         2) Compressive Strength: 16 psi, minimum.
         3) Thermal Resistance, R-value: At 1 inch thick; 6.0, minimum, at 75 degrees F.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

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3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Board Size: 48 inch by 96 inch.
5. Board Thickness: As indicated on the drawings.
6. Board Edges: Square.
7. Products:
   a. Basis of Design: DuPont de Nemours, Inc; Thermax (ci): building.dupont.com.
   b. GAF: www.gaf.com.
   c. Johns Manville: www.jm.com.

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
   3. Formaldehyde Content: Zero.
   4. Thermal Resistance: R-value of 19.
   5. Thickness: 6 inch.
   6. Facing: Unfaced.
   7. Products:
      a. CertainTeed Corporation: www.certainteed.com.
      b. Johns Manville: www.jm.com/#sle.
      c. Owens Corning Corporation: www.ocbuildingspec.com.

2.4 ACCESSORIES

A. Sheet Vapor Retarder: See Section 072600.

B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

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B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches wide sealant tape; comply with ASTM E2357.

C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.

F. Tape insulation board joints.

3.3 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Retain insulation batts in place with wire mesh secured to framing members.

F. Coordinate work of this section with requirements for vapor retarder, see Section 072600.

G. Coordinate work of this section with construction of air barrier seal, see Section 072700.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:
   1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
   2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

3.5 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

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SECTION 072400 - EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Composite wall cladding of rigid insulation and reinforced finish coating, Class PB.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Sheathing on framing members.

B. Section 072500 - Weather Barriers.

C. Section 076200 - Sheet Metal Flashing and Trim: Perimeter flashings.

D. Section 079200 - Joint Sealants: Sealing joints between EIFS and adjacent construction and penetrations through EIFS.

1.3 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

C. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage.

D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.

E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity.

F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

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

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS).

J. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

K. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials.

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L. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems.

M. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies.

N. NFPA 259 - Standard Test Method for Potential Heat of Building Materials.

O. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

P. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

C. Shop Drawings: Indicate wall joint patterns, joint details, and molding profiles.

D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.

E. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.

F. Delegated Design Documents: Drawings and calculations sealed by Structural Engineer.

G. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

H. Designer's qualification statement.

I. Installer's qualification statement.

1.5 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.

B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
1. Member in good standing of EIMA (EIFS Industry Members Association).
2. Manufacturer of EIFS products for not less than 5 years.

C. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.6 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

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B. Construct mock-up of typical EIFS application on specified substrate, size as required to include examples of all key conditions, and including flashings, joints, and edge conditions.

C. Locate mock-up where directed.

D. Approved mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Store materials as directed by manufacturer's written instructions.
1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
3. Protect insulation materials from exposure to sunlight.

1.8 FIELD CONDITIONS

A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.9 WARRANTY

A. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

B. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:
1. Dryvit Systems, Inc; Dryvit Outsulation EIFS, Class PB: www.dryvit.com/#sle.

B. Other Acceptable Exterior Insulation and Finish Systems Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

2.2 EXTERIOR INSULATION AND FINISH SYSTEM

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A. Exterior Insulation and Finish System: BARRIER type; reinforced finish coating on insulation board adhesive-applied direct to substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

D. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.

E. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

F. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

G. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

H. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

I. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

J. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
   1. Standard: 25 to 49 in-lb, for areas not indicated as requiring higher impact resistance.

2.3 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: Dryvit Systems, Inc, with Hydrophobic (HDP) Additive; Sandpebble HDP: www.dryvit.com/#sle.
   2. Color: As selected by Architect from manufacturer's standard range.

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B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with insulation board and reinforcing mesh, Class PB.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578, with natural skin surfaces.
1. Board Size: 24 by 48 inch.
2. Board Size Tolerance: 1/16 inch from square and dimension.
3. Board Thickness: 2 inches.
4. Board Edges: Square.
5. Type and Thermal Resistance, R-value (RSI-value): Type X, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
6. Type and Compressive Resistance: Type X, 15 psi (104 kPa), minimum.
7. Type and Board Density: Type X, 1.30 pcf (21 kg/cu m), minimum.
8. Type and Water Absorption: Type X, 0.3 percent by volume, maximum, by total immersion.
9. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.

E. Flashing Tape: Self-adhering rubberized asphalt tape with polyethylene backing or other material and surface conditioner furnished or approved by EIFS manufacturer.

2.4 ACCESSORIES

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Trim: EIFS manufacturer's standard galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

C. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.2 PREPARATION

A. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

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3.3 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
   1. Where different requirements appear in either document, comply with the most stringent.
   2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.4 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Prior to installation of boards, install starter track and other trim level and plumb and securely fastened. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.

C. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

D. On wall surfaces, install boards horizontally. On horizontal surfaces, install boards _____ .

E. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch.

F. Fill gaps greater than 1/16 inch with strips or shims cut from the same insulation material.

G. Rasp irregularities off surface of installed insulation board.

H. Adhesive Attachment: Use method recommended by EIFS manufacturer.

3.5 INSTALLATION - CLASS PM FINISH

A. Joints: Install control and expansion joints at spacings indicated on drawings. Do not exceed 150 sq ft for areas defined by the placement of control joints.

B. Reinforcing Mesh: Install in strict accordance with manufacturer's instructions, using mechanical fasteners at spacing recommended.
   1. Lap reinforcing mesh edges and ends 2 inches minimum.

C. Base Coat: Install to minimum thickness specified, following manufacturer's instructions. Leave base coat in condition suitable to receive finish coat.

D. Finish Coat: Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.
   1. Thickness: As recommended by manufacturer.

E. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.6 CLEANING

A. See Section 017700 - Closeout Procedures for additional requirements.

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B. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.7 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION 072400

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SECTION 072600 - VAPOR RETARDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Underslab vapor retarders.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

1.3 DEFINITIONS

A. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to degree specified, with seams and joints sealed to adjacent surfaces.

B. Vapor Retarder Class: A measure of a material or assembly's ability to limit the amount of moisture that passes through that material or assembly. Vapor retarder class is defined using Procedure A, Desiccant Method at 73 degrees F and 50 percent Relative Humidity (RH), in accordance with ASTM E96/E96M and ICC (IBC)-2018, as follows:
   1. Class I: 0.1 perm or less.
   2. Class II: Greater than 0.1 perm to 1.0 perm.
   3. Class III: Greater than 1.0 perm to 10 perms.
   4. Vapor Permeable: 5 perms or greater.

1.4 REFERENCE STANDARDS

A. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

B. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

D. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

E. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

F. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

G. ICC (IBC)-2018 - International Building Code.

1.5 SUBMITTALS

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A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on material characteristics, performance criteria, and limitations.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.7 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.1 VAPOR RETARDERS

A. Sheet Vapor Retarder:
1. Basis of design product:
   a. Stego Wrap 15-Mil Vapor Barrier; Stego Industries, LLC: www.stegoindustries.com.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Class A when tested in accordance with ASTM E1745.
3. Thickness: Min. 15 mils.
4. Tensile Strength: 70.6 lbf/in when tested in accordance with ASTM D882.
5. Puncture Resistance: 2,266 grams when tested in accordance with ASTM D1709.
6. Water Vapor Permeance: 0.0086 perms when tested in accordance with ASTM F1249.

B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Pipe boots shall be constructed from the same vapor barrier material, tape and/or mastic per manufacturer’s instructions.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

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B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

C. Earth or granular fill under slabs shall be level and tamped or rolled prior to installation of slab vapor barrier.

3.2 INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.
   3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
   4. Lap joints 6 inches and seal with manufacturer's recommended tape.
   5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
   6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
   7. Protect vapor retarder during placement of reinforcement and concrete.
      a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.3 FIELD QUALITY CONTROL

A. Take digital photographs of each portion of installation prior to covering up vapor retarders.

3.4 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

B. Protect vapor retarders from damage until concealed by permanent construction. Foot traffic should be reduced to minimum to avoid punctures to the vapor barrier.

3.5 REPAIR

A. All punctures should be repaired with authorized tape and mastic according to manufacturer's instructions prior to placing the concrete.

END OF SECTION 072600

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SECTION 072700 - AIR BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air barriers.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture for exterior wall sheathing.

1.3 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.4 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

B. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

D. ASTM C1305/C1305M - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane.

E. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension.

F. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

G. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).

H. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

I. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

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

K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

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L. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

M. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

N. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on material characteristics, performance criteria, and limitations.

C. Shop Drawings: Provide drawings of special joint conditions.

1.6 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

B. Air Barrier Association of America (ABAA) Evaluated Air Barrier Assemblies; www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

D. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.

E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.7 MOCK-UPS

A. Construct air barrier mock-up, 10 feet long by 20 feet wide, indicating workmanship and detailing at openings.

B. Locate where directed.

C. Mock-up may remain as part of work.

1.8 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

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PART 2 PRODUCTS

2.1 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR IMPERMEABLE)

A. Air and Vapor Barrier Sheet, Self-Adhered:
1. Air Permeance: 0.002 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 0.05 perms, maximum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
3. Water Penetration Resistance Around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).
4. Pliability: At 180° bend over 1 in. (25 mm) mandrel, pass when tested in accordance with ASTM D1970/D1970M.
5. Minimum Tensile Strength: 400 psi (2.8 MPa), when tested in accordance with ASTM D412.
6. Minimum Elongation: 200 percent when tested in accordance with ASTM D412.
7. Minimum Puncture Resistance: 40 lbs (178 N) when tested in accordance with ASTM E154/E154M.
8. Lap Peel Adhesion at Minimum Application: 4 lbs/in. width (700 N/m) when tested in accordance with ASTM D1876.
9. Water Absorption: 0.1 percent (weight gain at 24 hours) when tested in accordance with ASTM D570.
10. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 90 of weather exposure.
11. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
12. Complies with NFPA 285 requirements for wall assembly.
13. Seam and Perimeter Tape: As recommended by sheet manufacturer.
14. Products:
    a. Basis of Design: GCP Applied Technologies; PAB Wall Membrane Sheet: www.gcpat.com.
    b. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com.
    c. Elevate: www.holcimelevate.com.
    d. Substitutions: See Section 016000 - Product Requirements.

2.2 ACCESSORIES

A. All accessory products to be from same manufacturer as sheet product to form a complete air barrier system.

B. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.

C. Primer: Water-based liquid applied polymer.
1. Color: Green.
2. Products:
    a. Basis of Design; GCP Applied Technologies; Perm-A-Barrier WB Primer: www.gcpat.com.
    b. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com.

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c. Elevate: www.holcimelevate.com.
d. Substitutions: See Section 016000 - Product Requirements.

D. Foil-Faced Self-Adhering Flashing: Membrane consisting of cross-laminated high-density polyethylene facer laminated to ultraviolet (UV) and weather-resistant exterior aluminum foil facer, using nonasphaltic, butyl-based adhesive to self-adhere to substrate.
1. Thickness: 40 mil, 0.040 inch, minimum.
2. Roll Size: 50 feet long by 4 inches wide or as required to bridge openings with a single roll width.
3. Color: Silver aluminum.
4. Tensile Strength, Membrane: 600 psi, minimum, when tested in accordance with ASTM D412.
5. Tensile Strength, Film: 4000 psi, minimum, when tested in accordance with ASTM D412.
6. Minimum Elongation (to failure of rubberized asphalt): 200 percent, whe tested in accordance with ASTM D412.
7. Pliability: At 180° bend over 1 in. (25 mm) mandrel: pass when tested in accordance with ASTM D1970/D1970M.
8. Crack Cycling, 1/8in. (3.2 mm) at -25°F (-32°C): unaffected when tested in accordance with ASTM C836/C836M.
9. Minimum Puncture Resistance: 80 lbs when tested in accordance with ASTM E154/E154M.
10. Water Absorption: 0.1 percent (weight gain at 24 hours) when tested in accordance with ASTM D570.
11. Products:
    a. Basis of Design; GCP Applied Technologies; Perm-A-Barrier Aluminum Flashing: www.gcpat.com.
    b. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com.
    c. Elevate: www.holcimelevate.com.
    d. Substitutions: See Section 016000 - Product Requirements.

E. Preformed Transition Membrane: Self-adhesive, rubberized asphalt/polyethylene detail membrane, tapered edges, tear resistant.
1. Thickness: 3/64 inches (1 mm), minimum.
2. Roll Size: 75 feet long by 6 inches wide or as required to bridge openings with a single roll width.
3. Color: Green.
4. Tensile Strength, Membrane: 400 psi, minimum, when tested in accordance with ASTM D412.
5. Tensile Strength, Film: 5000 psi, minimum, when tested in accordance with ASTM D412.
6. Minimum Elongation (to failure of rubberized asphalt): 200 percent, whe tested in accordance with ASTM D412.
7. Pliability: At 180° bend over 1 in. (25 mm) mandrel, pass when tested in accordance with ASTM D1970/D1970M.
8. Crack Cycling, 1/8in. (3.2 mm) at -25°F (-32°C): unaffected when tested in accordance with ASTM C836/C836M.
9. Minimum Puncture Resistance: 40 lbs (178 N) when tested in accordance with ASTM E154/E154M.

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10. Lap Peel Adhesion at Minimum Application: 4 lbs/in. width (700 N/m) when tested in accordance with ASTM D1876.
11. Maximum Permeance to Water Vapor Transmission: 0.05 perms/(Pa.s.m) (2.9 ng) whe tested in accordance with ASTM E96/E96M.
12. Air Permeance: 0.0002 cf/min/ft (<0.001 L/s/m) when tested in accordance with ASTM D2178/D2178M.
13. Water Absorption: 0.1 percent (weight gain at 24 hours) when tested in accordance with ASTM D570.
14. Products:
    a. Basis of Design; GCP Applied Technologies; Perm-A-Barrier Detail Membrane: www.gcpat.com.
    b. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com.
    c. Elevate: www.holcimelevate.com.
    d. Substitutions: See Section 016000 - Product Requirements.

F. Liquid Flashing: One part, fast curing, nonsag, elastomeric, gun grade, trowelable.
1. Hardness (Shore A): >35 when tested in accordance with ASTM C661.
2. Minimum Elongation (to failure of rubberized asphalt): 600 percent, whe tested in accordance with ASTM D412.
3. Ultimate Tensile Strength: 150 psi when tested in accordance with ASTM D412.
4. Modulus at 100 Percent Elongation: 50 psi when tested in accordance with ASTM D412.
5. Elastomeric Joint Sealants: Class 50 when tested in accordance with ASTM C920.
6. Water Vapor Permeance: 15 perms when tested in accordance with ASTM E96/E96M.
7. Water Penetration Around Nails: Pass when tested in accordance with ASTM D1970/D1970M.
8. Crack Bridging Ability: Category I, Pass when tested in accordance with ASTM C1305/C1305M.
9. Products:
    a. Basis of Design: GCP Applied Technologies; Perm-A-Barrier Universal Flashing and Sealant: www.gcpat.com.
    b. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com.
    c. Elevate: www.holcimelevate.com.
    d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready for work of this section.

B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

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B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.

D. Self-Adhered Sheets:
1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
2. Lap sheets shingle fashion to shed water and seal laps airtight.
3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
4. Use same material, or other material approved by sheet manufacturer, to seal to adjacent substrates, and as flashing.
5. At wide joints, provide extra flexible membrane allowing joint movement.

E. Openings and Penetrations in Exterior Air Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Do not cover installed air barriers until required inspections have been completed.

C. Obtain approval of installation procedures from air barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

D. Take digital photographs of each portion of installation prior to covering up air barriers.

3.5 PROTECTION

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A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 072700

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SECTION 073113 - ASPHALT SHINGLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphalt shingle roofing.

B. Flexible sheet membranes for eave protection, underlayment, and valley protection.

C. Flashing.related to roofing.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Roof sheathing.

B. Section 072100 - Thermal Insulation: Nailable rigid insulation.

C. Section 076200 - Sheet Metal Flashing and Trim: Thru-wall flashing.

D. Section 077123 - Manufactured Gutters and Downspouts.

1.3 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

B. ASTM D3161/D3161M - Standard Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method).

C. ASTM D3462/D3462M - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

E. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.

F. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

G. NRCA (RM) - The NRCA Roofing Manual.

H. UL (DIR) - Online Certifications Directory.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.

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C. Shop Drawings: For metal flashings, indicate specially configured metal flashings, jointing methods and locations, fastening methods and locations, and installation details.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements for additional provisions.
2. Extra Shingles: 100 sq ft of each type and color.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of roofing systems similar to those required for this project, with not less than 5 years of documented experience.

1.6 MOCK-UPS

A. Provide mock-up of 200 sq ft, including underlayment, shingles, eave protection membrane, and associated flashings.

B. Locate as directed by Architect.

C. Mock-up may remain as part of work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.

B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

D. When storing roofing materials on roofing system ensure no damage occurs to supporting members and other materials.

1.8 FIELD CONDITIONS

A. Do not install shingles, eave protection membrane or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.9 QUALITY ASSURANCE

A. Roofing system must be installed by a Contractor certified by the roofing manufacturer.

1.10 WARRANTY

A. Provide 25 year manufacturer's warranty for coverage against black streaks caused by algae.

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B. Provide 15 -year manufacturer's warranty for wind damage.

C. Lifetime warranty that includes materials and labor for 50-year period commencing on Date of Substantial Completion and materials only thereafter.

D. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Asphalt Shingles:
1. Basis of Design: Owens Corning Corporation; TruDefinition Duration Flex: www.owenscorning.com/en-us.
2. CertainTeed; Landmark PRO Solaris: www.certainteed.com.
3. GAF; Timberline HDZ RS Shingles: www.gaf.com.
4. Tamko Building Products, LLC; Heritage Series: www.tamko.com
5. Substitutions: See Section 016000 - Product Requirements.

B. Algae Resistant Asphalt Shingles:

2.2 ASPHALT SHINGLES

A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462/D3462M.
1. Fire Resistance: Class A, complying with ASTM E108.
2. Wind Resistance: Class F, when tested in accordance with ASTM D3161/D3161M.
3. Fire or Wind Resistance Criteria: Provide UL (DIR) listed and labeled products.
4. Warranted Wind Speed: Not greater than 110 mph.
5. Algae resistant.
6. Self-sealing type.
7. Style: Staggered edge butt.
8. Color: Match existing.

2.3 SHEET MATERIALS

A. Underlayment: Self-adhering butyl-rubber sheet complying with ASTM D1970/D1970M; strippable release film.
1. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
2. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
3. Obtain underlayment from the same manufacturer as the asphalt shingles.
4. Products:
   a. Basis of Design: Owens Corning Corporation; WeatherLock Flex: www.owenscorning.com/en-us.
   b. CertainTeed: www.certainteed.com.
   c. GAF: www.gaf.com.
   d. Tamko Building Products, LLC: www.tamko.com

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2.4 FLASHING

A. Metal Flashings: Provide sheet metal eave edge, ridge, ridge vents, open valley flashing, and other flashing as indicated.
   1. Form flashings to protect roofing materials from physical damage and shed water.
   2. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
   3. Hem exposed edges of flashings minimum 1/4 inch on underside.

2.5 ACCESSORIES

A. Roofing Nails: Standard round wire shingle type, galvanized steel or stainless steel, minimum 3/8-inch head diameter, 12-gauge, 0.109-inch nail shank diameter, 1-1/2 inches long and complying with ASTM F1667/F1667M.

B. Asphalt Roof Cement: ASTM D4586/D4586M, asbestos-free.

C. Bituminous Paint: Acid and alkali resistant type; black color.

D. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.

E. Plastic Ridge Vents: Extruded plastic with vent openings do not permit direct water or weather entry; flanged to receive shingles.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to starting this work.

B. Verify roof deck is of sufficient thickness to accept fasteners.

C. Verify roof penetrations and plumbing stacks are in place and flashed to deck surface.

D. Verify roof openings are correctly framed.

E. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.2 PREPARATION

A. Seal roof deck joints wider than 1/16 inch as recommended by shingle manufacturer.

B. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.

C. Broom clean deck surfaces before installing underlayment or eave protection.

D. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

E. Install eave edge flashings tight with fascia boards, weather lap joints 2 inches and seal with roof cement, and secure flange with nails spaced 6 inches on center.

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3.3 INSTALLATION

A. Eave Protection Underlayment:
   1. Install eave protection membrane from eave edge to minimum 48 inches up-slope beyond interior face of exterior wall.
   2. Apply 4-inch wide band of plastic cement over deck flange of eave edge flashings and embed an 18-inch wide strip of eave protection membrane. Place starter strip with eave edge flush with face of flashings, secure in place, and lap ends minimum 6 inches.
   3. Apply lap cement at rate of approximately 1.25 gal/100 sq ft over starter strip.
   4. Starting from lower edge of starter strip, lay additional 36-inch wide strips in lap cement to produce a 2-ply membrane. Weather lap plies minimum 19 inches and nail in place; lap ends minimum 6 inches and stagger end joints of each consecutive ply.

B. Underlayment:
   1. Roof Slopes Up to 4:12: Install two layers of underlayment over area not protected by eave protection, with ends and edges weather lapped minimum 4 inches; stagger end laps of each consecutive layer and nail in place.
   2. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.

C. Metal Flashing:
   1. Install flashings in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
   2. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
   3. Secure in place with nails at 6 inches on center, and conceal fastenings.
   4. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

D. Shingles:
   1. Install shingles in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
      a. Fasten individual shingles using two nails per shingle, or as required by manufacturer and local building code, whichever is greater.
      b. Fasten strip shingles using four nails per strip, or as required by manufacturer and local building code, whichever is greater.
   2. Place shingles in straight coursing pattern with 5-inch weather exposure to produce double thickness over full roof area, and provide double course of shingles at eaves.
   3. Project first course of shingles 3/4 inch beyond fascia boards.
   4. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
   5. Cap hips with individual shingles, maintaining 5-inch weather exposure, and place to avoid exposed nails.
   6. After installation, place one daub of plastic cement 1-inch diameter under each individual shingle tab exposed to weather to prevent lifting.
   7. Coordinate installation of roof mounted components or work projecting through roof with weathertight placement of counterflashings.
   8. Complete installation to provide weathertight service.

3.4 CLEANING

A. See Section 017700 - Closeout Procedures for additional requirements.

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B. Clean exposed work upon completion of installation; remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to finish.

3.5 PROTECTION

A. Do not permit traffic over finished roof surface; protect roofing until completion of project.

B. Touch-up, repair, or replace damaged asphalt shingles or accessories before Date of Substantial Completion.

END OF SECTION 073113

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SECTION 074113 - METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal roof panel system of preformed aluminum panels.

B. Metal mansard roof system of preformed aluminum panels.

C. Metal soffit panel system of preformed aluminum panels.

D. Metal wall panel (back of parapet) system of preformed aluminum panels

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Roof sheathing.

B. Section 077100 - Roof Specialties: Fascias.

C. Section 077123 - Manufactured Gutters and Downspouts.

D. Section 079200 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.3 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

F. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

G. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

H. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.

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I. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Summary of test results, indicating compliance with specified requirements.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Specimen warranty.

C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
1. Show work to be field-fabricated or field-assembled.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each roofing system specified, submit samples of minimum size 6 inches square, representing actual roofing metal, thickness, profile, color, and texture.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Test Reports: Indicate compliance of metal roofing system to specified requirements.

I. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 MOCK-UPS

A. Provide mock-up of 100 sq ft, including underlayment, shingles, eave protection membrane, and associated flashings.

B. Locate as directed by Architect.

C. Mock-up may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

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B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.8 FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.9 WARRANTY

A. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

B. Special Warranty: Provide 2-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide metal roof, mansard and soffit panels by same manufacturer as fascia panels in Section 077100 - Roof Specialties.

B. Architectural Metal Roof and MansardPanel Manufacturers:
1. Basis of Design: Berridge Manufacturing Company; Single-Lock Zee-Lock Panel: www.berridge.com/#sle.
2. ATAS International, Inc: www.atas.com/#sle.
3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
4. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

C. Metal Soffit Panels Manufacturers:
1. Basis of Design: Berridge Manufacturing Company; Vented L-Panel Soffit: www.berridge.com/#sle.
2. ATAS International, Inc: www.atas.com/#sle.
3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
4. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

D. Metal Parapet Wall Panels Manufacturers:
1. Basis of Design: Berridge Manufacturing Company; FW-12 Panel: www.berridge.com/#sle.
2. ATAS International, Inc: www.atas.com/#sle.
3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
4. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

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A. Metal Roof, Soffit and Wall Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
   1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
      a. Dead Loads: Weight of roofing system.
      b. Live Loads: As required by ASCE 7.
   2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
   3. Wind Uplift: Class 90 wind uplift resistance of UL 580.
   4. Air Infiltration: Maximum 0.06 cfm/sq ft at air pressure differential of 6.24 lbf/sq ft, when tested according to ASTM E1680.
   5. Water Penetration: No water penetration when tested in accordance with procedures and recommended test pressures of ASTM E1646; perform test immediately following air infiltration test.
   6. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.
   7. Material: Aluminum.
   8. Minimum Thickness: 0.040 inch.

2.3 METAL ROOF, MANSARD, WALL AND SOFFIT PANELS

A. Metal Roof , Mansard, and Soffit Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Roof and Mansard Panels: Factory-formed panels with factory-applied finish.
   1. Aluminum Panels:
      a. Alloy and Temper: Aluminum complying with ASTM B209/B209M; temper as required for forming.
      b. Thickness: Minimum 18 gauge, 0.040 inch.
   2. Profile: Standing seam, with minimum 2-inch seam height; concealed fastener system for field seaming with special tool.
   3. Texture: Smooth.
   4. Length: Full length of roof slope, without lapped horizontal joints.
   5. Width: Maximum panel coverage of 16 inches.
   6. Color: As selected by Architect from manufacturer's standard line.

C. Metal Soffit Panels:
   1. Profile: Style as indicated, with venting provided.
   2. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch minimum thickness.
   3. Texture: Smooth.
   4. Width: Maximum panel coverage of 16 inches.
   5. Color: As selected by Architect from manufacturer's standard line.

D. Metal Wall Panels (back of soffit):
   1. Profile: Style as indicated.
   2. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch minimum thickness.
   3. Texture: Smooth.

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4. Width: Maximum panel coverage of 16 inches.
5. Color: As selected by Architect from manufacturer's standard line.

2.4 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.5 FABRICATION

A. Panels: Provide factory fabricated panels and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.6 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer’s standard line.
1. Products:
    a. Arkema, Inc; Kynar 500: www.arkema.com/#sle.
    b. Beckers Group; Beckry Fluor: www.beckers-group.com/#sle.
    c. PPG; Duranar: www.ppgmetalcoatings.com/#sle.
    d. Sherwin-Williams Company; Fluropon: www.coil.sherwin.com/#sle.
    e. Substitutions: See Section 016000 - Product Requirements.

2.7 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Underlayment: Self-adhering polymer modified asphalt sheet complying with ASTM D1970/D1970M, with strippable release film and top surface of woven polypropylene sheet.

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1. Sheet Thickness: 40 mils, 0.040 inch, minimum.
2. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
3. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
4. Water Vapor Permeance: 0.1 perm, maximum, when tested in accordance with ASTM E96/E96M using Desiccant Method (Method A).
5. Functional Temperature Range: Minus 45 degrees F to 250 degrees F.
6. Products:
   a. Basis of Design: Carlisle Companies, Inc.; WIP 250HT: www.carlislewipproducts.com.
   b. Certainteed Roofing; WinterGuard Metal Waterproofing Underlayment: www.certainteed.com/#sle.
   c. GCP Saint-Gobain; Grace Ice and Water Shield: www.gcpat.com.
   d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation of preformed metal roof panels 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. Broom clean wood sheathing prior to installation of roofing system.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

C. Coordinate installation of waterproof membrane over roof sheathing with Section 061001.

D. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

E. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

F. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

G. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.

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1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, closure strips, preformed crickets, caps, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.
1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by panel manufacturer.
2. Provide sealant tape or other approved joint sealer at lapped panel joints.
3. Install sealant or sealant tape at end laps and side joints as recommended by metal roof panel manufacturer.

3.4 CLEANING

A. See Section 017700 - Closeout Procedures for additional requirements.

B. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 074113

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SECTION 074646 - FIBER-CEMENT SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fiber-cement panel system and trim.

1.2 RELATED REQUIREMENTS

A. Section 072700 - Air Barriers: Fluid-applied membrane air barrier.

B. Section 099113 - Exterior Painting: Field painting.

1.3 REFERENCE STANDARDS

A. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
1. Manufacturer's requirements for related materials to be installed by others.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods, including fastener patterns.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
1. Provide detailed drawings of atypical non-standard applications of cladding junctions and penetrations which are outside the scope of the standard details and specifications provided by the manufacturer.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

F. Installer's qualification statement.

G. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.5 QUALITY ASSURANCE

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A. Installer Qualifications: Company specializing in performing work of type specified in this section with not less than three years of experience.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques.
   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.
   4. Approved mock-up may remain part of the finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.

B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

C. Store siding flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

1.7 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.8 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer product warranty for 30 years against manufacturing defects. Complete forms in Owner's name and register with manufacturer.

C. Application Warranty: Application limited warranty for 2 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT PANEL SYSTEM

A. Basis of Design: Hardie Reveal Panel System; James Hardie Building Products, Inc.; www.jameshardie.com.
   1. Substitutions: See Section 016000 - Product Requirements.

B. Panel Siding: Vertically oriented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for screw attachment.

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1. Texture: Stucco patterned.
2. Length (Height): 96 inches, nominal.
3. Width: 48 inches.
4. Thickness: 5/16 inch, nominal.
5. Finish: Factory applied primer.
6. Warranty: 50 year limited; transferable.

C. Cement Fiber Soffit Panels: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186, Type A, Grade II; with machined edges, for nail attachment.
1. Texture: Smooth.
2. Vented panels at locations indicated on the drawings.
3. Length: 96 inches, nominal.
4. Width: 24 inches unless indicated otherwise.
5. Thickness: 5/16 inch, nominal.
6. Finish: Unfinished.
7. Manufacturer: Same as siding.

2.3 ACCESSORIES

A. Furring Strips, Metal: Galvanized metal channels.

B. Trim: Same material and texture as siding.

C. Fasteners:
1. For attaching Hardie Reveal Panel direct to sheathing provide the following:
   a. Steel Framing, Countersunk Screws: No. 8 by 0.390 inch (9.91 mm) head diameter by 1-5/8 inch (41 mm) long.
   b. Fasteners shall be of high quality stainless steel to ensure resistance to corrosion. For field painting, fasteners shall be treated to accept paint adhesion.
2. Fasteners to be placed at 16 inches o.c. horizontally and 16 inches o.c. vertically
   a. Approximately 21 fasteners per 8 foot by 4 foot panel.
   b. Hardie Reveal Panel fastener configuration #10.

2.4 FINISHES

A. Panels:
1. Primer: Factory applied sealer/primer by James Hardie. Apply flat sheen finishes to panels.
2. Topcoat: Refer to Section 099113 - Exterior Painting.

B. Trim:
1. Factory finish for field-applied topcoat: Chem film.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

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B. Do not begin until unacceptable conditions have been corrected.

3.2 PREPARATION

A. Protect surrounding areas and adjacent surfaces during execution of this work.

B. Clean surfaces thoroughly prior to installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

D. Ensure that drainage plane in intact and all penetrations are sealed.

3.3 INSTALLATION

A. Install siding in accordance with manufacturer's instructions and recommendations.
   1. Read warranty and comply with terms necessary to maintain warranty coverage.

B. Use trim details as indicated on drawings.

C. Touch up field cut edges before installing.

D. Pre-drill fastening holes if necessary to prevent breakage.

E. Installation:
   1. Fastening Method: Countersunk and filled.
   2. Place fasteners no closer than 3/4 inch (9.5 mm) from panel edges and 2 inches (51 mm) from panel corners.
   3. Use fasteners as specified in the James Hardie Tech Data sheet and in the Hardie Reveal Panel Installation Instruction.
   4. Install panel using 1/2 inch (13 mm) spacers at horizontal joints. Leave bottom edge of panel above all horizontal trims exposed, no caulking shall be placed at this overlap of Horizontal Reveal Trim. Factory primed edge shall always be used.
   5. Install a kickout flashing to deflect water away from the siding at the roof intersection.
   6. Install a self-adhering membrane on the wall before the subfascia and trim boards are fastened in place, and then install the kickout.
   7. Allow minimum vertical clearance between the bottom edge of siding and any other material in strict accordance with the manufacturer's installation instructions and as determined by James Hardie Zone.
   8. Maintain clearance between siding and adjacent finished grade.
   9. Specific framing and fastener requirements - refer to the applicable building code compliance reports.

F. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.

3.4 FINISHING

A. Finish factory primed siding as schedule in 099113 - Exterior Painting within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

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B. Field cut edges shall be coated during the installation process using an exterior grade primer/sealer that is compatible with the type of paint to used on project.

3.5 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 074646

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SECTION 075423 - THERMOPLASTIC-POLYOLEFIN ROOFING (TPO)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. TPO membrane roofing system and accessories.

B. Cover board.

C. Insulation.

D. Deck sheathing.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Wood nailers associated with roofing and roof insulation.

B. Section 076200 - Sheet Metal Flashing and Trim: Formed metal flashing and trim items associated with roofing.

C. Section 077100 - Roof Specialties: Manufactured copings, fascias, gravel stops, and other flashing-related items.

D. Section 077200 - Roof Accessories: Roof hatches, vents, and manufactured curbs.

E. Section 079100 - Preformed Joint Seals: Expansion joints.

1.3 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

B. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

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

D. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.

E. FM DS 1-28 - Wind Design.

F. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components.

G. NRCA (RM) - The NRCA Roofing Manual.

H. PS 1 - Structural Plywood.

I. PS 20 - American Softwood Lumber Standard.

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1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with installation of associated counter flashings and roof drainage components installed under other sections.

B. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Agenda:
      a. Sequence of construction.
      b. Coordination with substrate preparation.
      c. Roofing materials approved for use.
      d. Compatibility of materials.
      e. Coordination with installation of adjacent and covering materials.
      f. Construction details.
   2. Require attendance of parties directly influencing roofing work quality or affected by roofing work performance.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data:
   1. Provide membrane manufacturer's printed data showing roofing system components, including insulation and fasteners, comply with specified requirements and with membrane manufacturer's requirements and recommendations for system type specified; include data for each product used in conjunction with roofing membrane.
   2. Where UL or FM requirements are specified, provide documentation showing roofing system is UL classified or FM approved, as applicable; include data-itemizing components of classified or approved system.
   3. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show how components will be installed; where instructions allow installation options, clearly indicate which option will be used.

C. Shop Drawings: Indicate membrane manufacturer's standard details, drawn to scale and customized for project for relevant conditions.
   1. Include flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
   2. For tapered insulation, indicate project-specific layout, slopes, thicknesses, and dimensions.

D. Samples: Submit samples of the following:
   1. Sample of roof membrane.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Preinstallation Notice: Provide copy of manufacturer's approved preinstallation notice.

G. Installer's qualification statement.

H. Executed warranty.

I. Specimen Warranty: Submit prior to starting work.

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this section with minimum five years of documented experience installing specified system and having the following:
   1. Certified by roof membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.

B. Store materials clear of ground and moisture with weather-protective covering.

C. Keep combustible materials away from ignition sources.

D. Protect foam insulation from direct exposure to sunlight.

E. Store materials so that they are secured from any movement from wind uplift or any other environmental factor.

1.8 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather or when ambient conditions conflict with manufacturer's installation instructions.

B. Schedule applications so no partially completed sections of roof are left exposed at end of workday.

1.9 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Comply with warranty procedures required by manufacturer, including notifications, scheduling, and inspections.

C. System Warranty: Manufacturer's limited warranty covering membrane, roof insulation, and other specified system components for term indicated.
   1. Liability Limit: No dollar limitation.
   2. Scope of Coverage: Repair leaks in roofing system caused by:
      a. Ordinary wear and tear of elements.
      b. Manufacturing defect in materials.
      c. Defective workmanship used to install materials.
      d. Damage due to winds up to 100 mph.
      e. Hail up to 2 inches in diameter.

D. Metal Roof Edging:
   1. System Warranty: Include edge metals in membrane manufacturer's full system warranty.
   2. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

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PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Membrane Roofing System:
   1. Basis of Design: GAF Materials, LLC: www.gaf.com.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation Manufacturer: Same manufacturer as roof membrane.

C. Metal Roof Edging Manufacturer: Same manufacturer as roof membrane.
   1. Metal roof edging products by other manufacturers are unacceptable.
   2. Field- or shop-fabricated metal roof edgings are unacceptable.

2.2 MEMBRANE ROOFING SYSTEM

A. Description: TPO single-ply membrane.
   1. Membrane Attachment: Fully adhered.
   2. Warranty: Full system warranty; 30-year Platinum limited warranty covering membrane, roof insulation, and membrane accessories.
   3. Comply with applicable local building code requirements.
   4. Provide assembly having Underwriters Laboratories, Inc. (UL) Class B fire hazard classification.
   5. Provide assembly complying with Factory Mutual Corporation (FM) roof assembly classification, FM DS 1-28 and FM DS 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.

B. Roofing System Components: Listed in order from top of roof down:
   1. Membrane: Thickness as specified.
   2. Insulation (including combination insulation/coverbo:
      a. Maximum Board Thickness: 2.5 inches; use as many layers as necessary; stagger joints in adjacent layers.
      b. Total System R-value: 25, minimum.

2.3 MEMBRANE MATERIALS

A. Membrane: Flexible, heat-weldable sheet composed of TPO polymer and ethylene propylene rubber; complying with ASTM D6878/D6878M, with polyester weft-inserted reinforcement and the following additional characteristics:
   1. Polyester fleece backing.
   2. Thickness: 0.08 inch plus/minus 10 percent, with coating thickness over reinforcement of 0.03 inch plus/minus 10 percent.
   3. Sheet Width: Provide widest available sheets to minimize field seaming.
   4. Solar Reflectance: 0.79, minimum, when tested in accordance with ASTM C1549.
   5. Color: White.
   6. Products:
      a. Everguard Extreme 80-mil fleece back TPO Membrane

B. Curb and Parapet Flashing: Same material as membrane, with encapsulated edge eliminating need for seam sealing flashing-to-roof splice; precut to 18 inches wide.

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C. Formable Flashing: Nonreinforced, flexible, heat-weldable sheet, composed of TPO polymer and ethylene propylene rubber.
   1. Thickness: 0.06 inch plus/minus 10 percent.
   2. Product: Elevate; UltraPly TPO Flashing.

D. Pourable Sealer: Manufacturer's recommended two-part polyurethane, two-color for reliable mixing.

E. Cut Edge Sealant: Use manufacturer's recommended sealant for exposed membrane reinforcement.

F. General Purpose Sealant: Manufacturer's recommended, one part, white.

G. Molded Flashing Accessories: Unreinforced TPO membrane premolded to suit variety of flashing details, including pipe boots, inside corners, outside corners, etc.
   1. Product: Elevate; UltraPly TPO Small and Large Pipe Flashing.

H. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.1 inch thick.
   1. Product: Elevate; Termination Bar.

2.4 INSULATION

A. Polyisocyanurate Board Insulation (bottom layer): Closed-cell polyisocyanurate foam laminated to facers, complying with ASTM C1289, Type II, Class 1, with the following additional characteristics:
   1. Compressive Strength: 20 psi when tested in accordance with ASTM D1621.
   2. Ozone Depletion Potential: Zero; made without CFC- or HCFC-blowing agents.
   3. Recycled Content: 19 percent post-consumer and 15 percent pre-consumer (post-industrial), average.

B. Composite OSB and Polyisocyanurate Board Insulation (top layer): Closed-cell polyisocyanurate foam complying with ASTM C1289, Type V, laminated to oriented-strand board (OSB), with glass-fiber-reinforced mat on other face and the following characteristics:
   1. OSB Thickness: 7/16 inch.
   2. Foam Compressive Strength: 20 psi when tested in accordance with ASTM D1621.
   3. Recycled Content, Foam Component: 19 percent post-consumer and 15 percent pre-consumer (post-industrial), average.

2.5 EXPANSION JOINTS

A. See Section 079100 - Preformed Joint Seals.

2.6 ACCESSORIES

A. Wood Nailers: PS 20 dimension lumber, Structural Grade No. 2 or better Southern Pine, Douglas Fir; or PS 1, APA Exterior Grade plywood; pressure preservative treated.
   1. Do not use asphaltic or creosote-treated lumber.
   2. Do not use lumber treated with wood preservatives, such as pentachlorophenol, copper naphthenate, or copper 8-quinolinolate.
   3. Width: 3-1/2 inches, nominal minimum, or as wide as nailing flange of roof accessory attached.

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4. Thickness: Same as thickness of roof insulation.

PART 3 EXECUTION

3.1 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for specified roofing system. Where manufacturer provides no instructions or recommendations, follow NRCA (RM) written requirements and industry standards. Comply with federal, state, and local regulations.

B. Obtain relevant instructions and maintain copies at project site for duration of installation period.

C. Do not start work until preinstallation notice has been submitted to manufacturer.

D. Provide temporary closures to ensure moisture does not damage completed roofing. Use flashings, terminations, and temporary closures to provide watertight installation.

E. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
1. Protect from spills and overspray from bitumen, adhesives, sealants, and coatings.
2. Protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within range of windborne overspray.
3. Protect finished areas of roofing system from roofing-related work traffic and traffic by other trades.

3.2 EXAMINATION

A. Examine roof deck to determine deck is sufficiently rigid to support installers and mechanical equipment so deflection will not strain or rupture roof components or deform deck.

B. Verify surfaces and site conditions are ready to receive work. Correct defects in substrate before commencing with roofing work.

C. Examine roof substrate to verify adequate slope to drains.

D. Verify specifications and drawing details are workable and not in conflict with roofing manufacturer's recommendations and instructions; start of work constitutes acceptable project conditions and requirements.

3.3 PREPARATION

A. Remove existing roof system down to roof deck, including existing composition base flashings. Dispose of materials properly. Perform asbestos removal in accordance with federal, state, and local regulations, and dispose of waste in legal manner.
1. At penetrations, remove existing flashings, including lead, asphalt, and mastic.
2. Remove loose and unsecured flashings at walls, curbs, and other vertical and sloped surfaces; remove mineral-surfaced and coated flashings; remove excessive asphalt to provide smooth, sound surface for new flashings.

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B. Take appropriate measures to ensure fumes from adhesive solvents are not drawn into building through air intakes.

C. Before proceeding, ensure roof surface is clean, dry, and smooth and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease, and other materials that may damage membrane.

D. Fill surface voids in immediate substrate greater than 1/4-inch wide with fill material acceptable insulation to membrane manufacturer.

E. Wood Nailers: Provide wood nailers at perimeters and other locations where indicated on drawings.
1. Install with 1/8-inch gap between each length and at each change of direction.

3.4 INSULATION INSTALLATION

A. Install insulation in accordance with manufacturer's written instructions.

B. Install only as much insulation as can be covered with completed roofing system before end of day's work or before onset of inclement weather.

C. Lay roof insulation in courses parallel to roof edges.

D. Neatly and tightly fit insulation to penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with manufacturer's recommended insulation. Do not leave roofing membrane unsupported over space greater than 1/4 inch.

E. Mechanical Fastening (Base Layer): Using specified fasteners and insulation plates, engage fasteners through insulation into deck to depth and in pattern required by membrane manufacturer.
1. Comply with specified Factory Mutual for FM Class requirements.

F. Cold Adhesive Attachment (Top Layers): Apply in accordance with membrane manufacturer's instructions and recommendations; "walk-in" individual roof insulation boards to obtain maximum adhesive contact.

3.5 SINGLE-PLY MEMBRANE INSTALLATION

A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax before attachment or splicing. Refer to membrane manufacturer's guidelines for minimum relaxation time.

B. Lay out membrane pieces so field and flashing splices are installed to shed water.

C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.

D. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.

E. Edge Securement: Secure membrane at locations where membrane terminates or goes through angle change greater than 2 in 12 inches using mechanically fastened reinforced perimeter

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fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.

1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches wide.

3.6 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.

B. Roofing Expansion Joints: Install as shown on drawings and as recommended by roofing manufacturer.

C. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces.

1. Extend flashing minimum 8 inches above membrane surface unless otherwise shown.
2. Use longest practical flashing pieces.
3. Evaluate substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
4. Complete splices between flashing and main roof sheet with specified splice adhesive before adhering flashing to vertical surfaces.

D. Flashing at Penetrations: Flash penetrations passing through membrane; make flashing seals directly to penetration.

1. Pipes, Round Supports, and Similar Items: Flash with specified premolded pipe flashings wherever practical; otherwise, use specified self-curing elastomeric flashing.
2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1-inch clearance from penetration; fill with manufacturer's pourable sealer, and slope to shed water.
3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide standard curb with flashing.
4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Inspection by Manufacturer: Provide final inspection of roofing system by technical representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes.

C. Perform corrections necessary for issuance of warranty.

3.8 CLEANING

A. Clean contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.

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B. Repair or replace building components and finished surfaces damaged or defaced due to work of this section; comply with recommendations of manufacturers of components and surfaces.

C. Remove leftover materials, trash, debris, and equipment from project site and surrounding areas.

3.9 PROTECTION

A. Where construction traffic continues over finished roof panels, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION 075423

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and exterior penetrations.

B. Sealants for joints within sheet metal fabrications.

1.2 RELATED REQUIREMENTS

A. Section 077123 - Manufactured Gutters and Downspouts.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

D. CDA A4050 - Copper in Architecture - Handbook.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

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B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Stainless Steel: ASTM A666/A666M, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch thick; smooth No. 4 - Brushed finish.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 GUTTERS AND DOWNSPOUTS

A. See Section 077123 for manufactured gutters and downspouts.

B. Seal metal joints.

2.4 ACCESSORIES

A. Fasteners: Stainless steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

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B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.3 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

END OF SECTION 076200

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SECTION 077100 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured roof specialties, including copings and fascias.

1.2 RELATED REQUIREMENTS

A. Section 077200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.3 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems.

B. NRCA (RM) - The NRCA Roofing Manual.

1.4 SUBMITTALS

A. See Section013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide metal roof and soffit panels by same manufacturer as roof, wall and soffit panels in Section 074113 - Metal Roof Panels.

B. Roof Edge Flashings and Copings:
1. Basis of Design: Berridge Manufacturing Company; FW-12 Panel: www.berridge.com/#sle.
2. ATAS International, Inc: www.atas.com/#sle.
3. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
4. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

2.2 COMPONENTS

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A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Fascia, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   3. Exposed Face Height: As indicated on drawings.
   4. Material: Formed aluminum sheet, 0.040 inch thick, minimum.
   5. Texture: Smooth.
   6. Finish: 70 percent polyvinylidene fluoride (PVDF).
   7. Color: As selected by Architect from manufacturer's standard range.
   8. Products:
      a. Basis of Design: Berridge Manufacturing Company; FW-12 Panel: www.berridge.com/#sle.
      b. ATAS International, Inc: www.atas.com/#sle.
      c. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
      d. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

2.3 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Seal joints within components when required by component manufacturer.

C. Anchor components securely.

D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

F. Coordinate installation of flashing flanges into reglets.

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END OF SECTION 077100

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SECTION 077123 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

B. Precast concrete splash pads.

1.2 RELATED REQUIREMENTS

A. Section 076100 - Sheet Metal Roofing.

1.3 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.

B. Comply with applicable code for size and method of rain water discharge.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

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2.1 MANUFACTURERS

A. Gutters and Downspouts:
   1. ATAS International, Inc; Custom Box Gutter; Box Downspout: www.atas.com.
   2. Hickman Edge Systems: www.hickmanedgesystems.com.
   3. Metal-Era Inc: www.metalera.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Provide sloped gutter liner.

2.2 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209/B209M; 0.063 inch thick.
   1. Finish: Plain, shop pre-coated with polyvinylidene fluoride (PVDF) coating.
   2. Color: As indicated.

2.3 COMPONENTS

A. Gutters: "A" style (box) square style profile with sloped gutter liner.

B. Downspouts: SMACNA rectangular profile.

C. Anchors and Supports: Profiled to suit gutters and downspouts.
   1. Anchoring Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

D. Fasteners: Same material and finish as gutters and downspouts, with soft neoprene washers.

2.4 FABRICATION

A. Form gutters, gutter liners and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.5 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.6 ACCESSORIES

A. Splash Pads: Precast concrete type, profiles size(s) as indicated; minimum 3,000 psi compressive strength at 28 days, with minimum 5 percent air entrainment.

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PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.

C. Slope gutters 1/16 inch per foot .

D. Set splash pads under downspouts.

END OF SECTION 077123

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SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof curbs.

B. Equipment rails.

C. Roof penetrations mounting curbs.

D. Rooftop mounted guardrails.

E. Roof hatches.

F. Non-penetrating pedestals.

1.2 RELATED REQUIREMENTS

A. Section 077100 - Roof Specialties: Other manufactured roof specialty items.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders.

B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.

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3. Installation methods.
4. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.

D. Warranty Documentation:
1. Submit manufacturer warranty.
2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.6 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for all items in this Section. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ROOF CURBS

A. Roof Curbs Manufacturers:
1. MKT Metal Manufacturing: www.mktduct.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
1. Roof Curb Mounting Substrate: Curb substrate consists of hollow-core concrete plank.
2. Sheet Metal Material:
a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
1) Finish: Mill finish.
3. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.

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C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
   1. Provide preservative treated wood nailers along top of rails.
   2. Height Above Finished Roof Surface: 8 inches, minimum.
   3. Products:
      a. MKT Metal Manufacturing: www.mktduct.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

D. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
   1. Provide sliding channel welded along top edge with adjustable height steel bracket, fabricated to fit item supported.
   2. Height Above Finished Roof Surface: 8 inches, minimum.

2.2 ROOF HATCHES AND VENTS

A. Personnel Roof Hatch Manufacturers:
   1. Basis of Design: Bilco Company; Type S (ladder access) - stainless steel: www.bilco.com/#sle.
   2. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
   3. Babcock-Davis: www.babcockdavis.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
   2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
   3. Curb Height: As indicated on drawings.

C. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
   3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
   4. Gasket: Neoprene, continuous around cover perimeter.

D. Hardware: Type 316 stainless steel, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior.
   6. Locking: Padlock hasp on interior.

2.3 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

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A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Height: Provide minimum clearance of 8 inches under supported items to top of roofing.
   3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   4. Steel Components: Stainless steel in accordance with ASTM A123/A123M.
   5. Hardware, Bolts, Nuts, and Washers: Stainless steel in accordance with ASTM A153/A153M.

B. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
   1. Railing Size: As indicated on drawings.
   2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with safety factor of two.
   3. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
   4. Posts and Rails: Fiberglass-reinforced polymer tubing.
   5. Gate: Same material as railing; automatic closing with latch.
   6. Finish: Manufacturer's standard, factory-applied.
   7. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
   8. Fasteners: Stainless steel, Type 316.
   9. Products:
      a. Basis of Design: BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

C. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.

D. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
   1. Bases: High density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

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.

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B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

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SECTION 078400 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping systems.

1.2 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.3 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies.

E. FM (AG) - FM Approval Guide.

F. ITS (DIR) - Directory of Listed Products.

G. UL (DIR) - Online Certifications Directory.

H. UL (FRD) - Fire Resistance Directory.

I. UL 1479 - Standard for Fire Tests of Penetration Firestops.

J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

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1.5 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Verification of minimum three years documented experience installing work of this type.

1.6 MOCK-UPS

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.

B. If accepted, mock-up will represent minimum standard for this work.

C. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.7 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop.
   2. Hilti, Inc: www.us.hilti.com.
   3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
   4. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

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C. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

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3.4 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

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SECTION 079100 - PREFORMED JOINT SEALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precompressed foam seals.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Liquid and mastic joint sealants and their backing materials.

1.3 REFERENCE STANDARDS

A. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's technical data sheets for each product, including chemical composition, movement capability, color availability, limitations on application, and installation instructions.

C. Color Cards: For color selection.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section with at least three years of documented experience.

1.6 WARRANTY

A. Correct defective work within a two year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealers that fail to achieve watertight seal or exhibit loss of adhesion or cohesion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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A. Precompressed Foam Seals:
   1. Basis of Design: EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
   2. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
   3. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

2.2 PRECOMPRESSED FOAM SEALS

A. Type Exterior Expansion Joint for Vertical (Wall) and Horizontal (Roof Trough) Applications - Precompressed Foam Seal: Comprised of urethane, modified-acrylic impregnated, open-cell polyurethane, or closed-cell neoprene foam impregnated with water-repellent, and with self-adhesive faces protected prior to installation by release paper.
   1. Color: As selected by Architect.
   2. Size as required to provide weathertight seal when installed.
   3. Calculate size according to manufacturer's recommendations.
   4. Measure size of existing joints before selecting seal width.
   5. Applications:
      a. Exterior wall expansion joints.
   6. Products:
      a. Basis of Design: EMSEAL Joint Systems, Ltd; Seismic Colorseal: www.emseal.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

B. Type Interior 1-hr Fire-Rated Expansion Joint - Precompressed Foam Seal, Fire-Retardant Impregnated: Comprised of waterproof silicone face on fire-retardant impregnated foam seal.
   1. Color: As selected by Architect.
   2. Size as required to provide water-tight seal when installed.
   3. Calculate size according to manufacturer's recommendations.
   4. Measure size of existing joints before selecting seal width.
   5. Fire-Rating: As indicated on drawings, comply with UL 2079.
   6. Applications:
      a. Fire-rated interior walls.
   7. Products:
      a. Basis of Design: EMSEAL Joint Systems, Ltd; Emshield WFR1: www.emseal.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

C. Type Interior Non-Rated Expansion Joint - Elastomeric seal.
   1. Color: As selected by Architect.
   2. Size as required to provide water-tight seal when installed.
   3. Calculate size according to manufacturer's recommendations.
   4. Measure size of existing joints before selecting seal width.
   5. Applications:
      a. Interior Non-Rated Walls and Ceilings.
   6. Products:
      a. Basis of Design: EMSEAL Joint Systems, Ltd; Sika Wabo Corridor Wrap: www.emseal.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

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2.3 ACCESSORIES

A. Adhesive: As recommended by seal manufacturer.

B. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and strip seal.

C. Substrate Cleaner: Non-corrosive, non-staining type recommended by seal manufacturer; compatible with joint forming materials.

D. Primer: Type recommended by seal manufacturer to suit application; non-staining.

E. Backing Tape: Self-adhesive polyethylene tape with surface that seal will not adhere to.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive this work.

B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

3.2 PREPARATION

A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Precompressed Foam Seals:
1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
3. Remove loose materials and foreign matter that could impair adhesion of sealant.
4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

A. Clean adjacent soiled surfaces.

3.5 PROTECTION

A. Protect joints from damage until adhesives have properly cured.

END OF SECTION 079100

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SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

A. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.3 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

B. ASTM C834 - Standard Specification for Latex Sealants.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants.

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.

G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

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D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.5 QUALITY ASSURANCE

A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver sufficient samples to manufacturer for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:
   1. Dow: www.dow.com.
   2. Sika Corporation: usa.sika.com.
   3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
   4. Substitutions: See Section 016000 - Product Requirements.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal the following joints:
         1) Joints between doors, windows, and other frames or adjacent construction.
         2) Joints between different exposed materials.
   2. Interior Joints:
      a. Do not seal interior joints indicated on drawings as not sealed.
      b. Do not seal gaps and openings in gypsum board and suspended ceilings
      c. Do not seal through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
      d. Seal the following joints:
         1) Joints between door frames and window frames and adjacent construction.
   3. Do Not Seal:
      a. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
      b. Joints where sealant installation is specified in other sections.
      c. Joints between suspended ceilings and walls.

B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
   1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
   2. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.

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3. Floor Joints in Wet Areas: Nonsag polyurethane non-traffic-grade sealant suitable for continuous liquid immersion.
4. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.

C. Interior Wet Areas: restrooms and break rooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

2.3 JOINT SEALANTS - GENERAL

A. Colors: As indicated on drawings.

2.4 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Color: To be selected by Architect from manufacturer's standard range.
5. Products:
   a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
   b. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
   c. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
2. Products:
   a. Dow Chemical Company; DOWSIL 786 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html.
   b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
   c. Tremco Commercial Sealants & Waterproofing: Tremsil 200; www.tremcosealants.com
   d. Substitutions: See Section 016000 - Product Requirements.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Service Temperature Range: Minus 40 to 180 degrees F.
4. Products:
   a. Pecora Corporation; DynaFlex: www.pecora.com.
   b. Sherwin-Williams Company; Stampede 2NS Polyurethane Sealant: www.sherwin-williams.com.

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c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's standard range.
2. Products:
a. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
b. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
c. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.

2.5 SELF-LEVELING JOINT SEALANTS

A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
2. Products:

2.6 ACCESSORIES

A. Sealant Backing Rod, Closed-Cell Type:
1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25 to 50 percent larger in diameter than joint width.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 079200

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Glass for doors and borrowed lites.

C. Section 099113 - Exterior Painting: Field painting.

D. Section 099123 - Interior Painting: Field painting.

1.3 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. ASCE: American Society of Civil Engineers.

C. HMMA: Hollow Metal Manufacturers Association.

D. NAAMM: National Association of Architectural Metal Manufacturers.

E. NFPA: National Fire Protection Association.

F. SCIF: Sensitive Compartmented Information Facility.

G. UL: Underwriters Laboratories.

1.4 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

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D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities.

K. ITS (DIR) - Directory of Listed Products.

L. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.

O. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames.

P. NAAMM HMMA 850 - Fire-Rated Hollow Metal Doors and Frames.

Q. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames.

R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.

S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.

U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

W. UL (DIR) - Online Certifications Directory.

X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

Y. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

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B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
3. Steelcraft, an Allegion brand: www.allegion.com.
4. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip

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process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

a. Based on NAAMM HMMA Custom Guidelines: Provide at least A25/ZF75 (galvannealed) for interior applications, and at least A60/ZF180 (galvannealed) or G60/Z180 (galvanized) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on NAAMM HMMA Custom Guidelines:
   a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
   b. Performance Level 3 - Heavy Duty, in accordance with NAAMM HMMA 805.
   c. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
   e. Zinc Coating: G90/Z275 galvanized coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.
4. Weatherstripping: Refer to Section 087100.

C. Interior Doors, Non-Fire-Rated:
1. Based on NAAMM HMMA Custom Guidelines:
   a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
   b. Performance Level 3 - Heavy Duty, in accordance with NAAMM HMMA 805.
   c. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
   e. Zinc Coating: G90/Z275 galvanized coating; ASTM A653/A653M.
2. Door Thickness: 1-3/4 inches, nominal.

D. Fire-Rated Doors:
1. Based on NAAMM HMMA Custom Guidelines: Comply with NAAMM HMMA 850 requirements for fire-rated doors.
   a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
   b. Performance Level 3 - Heavy Duty, in accordance with NAAMM HMMA 805.
   c. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.

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e. Zinc Coating: G90/Z275 galvanized coating; ASTM A653/A653M.

2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
4. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
   a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
   b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
   c. Label: Include the "S" label on fire-rating label of door.
5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inches, nominal.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 12 gauge, 0.093 inch, minimum.
3. Weatherstripping: Separate, see Section 087100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 12 gauge, 0.093 inch, minimum.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 12 gauge, 0.093 inch, minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Transom Bars: Fixed, of profile same as jamb and head.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

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B. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.6 ACCESSORIES

A. Glazing: As specified in Section 088000, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Install door hardware as specified in Section 087100.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Comply with glazing installation requirements of Section 088000.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

3.3 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

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3.4 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.2 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

B. Section 087100 - Door Hardware.

C. Section 088000 - Glazing.

1.3 REFERENCE STANDARDS

A. AWI (QCP) - Quality Certification Program.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.

D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of door veneer, 4 by 4 inches in size illustrating wood grain, stain color, and sheen.

E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

F. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

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A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of experience.

C. Woodwork Quality Assurance Program:
   1. Comply with AWI (QCP) woodwork association quality assurance service/program in accordance with requirements for work specified in this section; www.awiqcp.org/#sle.
   2. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   3. Provide designated labels on shop drawings as required by quality assurance program.
   4. Provide designated labels on installed products as required by quality assurance program.
   5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.7 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
   1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Basis of Design: VT Industries, Inc.: www.vtindustries.com.
   2. Masonite Architectural: www.architectural.masonite.com.
   3. Oshkosh Door Company: www.oshkoshdoor.com
   4. Substitutions: See Section 016000 - Product Requirements.

2.2 DOORS AND PANELS

A. Doors:

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1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
1. Provide solid core doors at each location.
2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is closed.
3. Wood veneer facing with factory transparent finish.

2.3 DOOR AND PANEL CORES

A. Non-Rated Solid Core Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

A. Veneer Facing for Transparent Finish: White oak, HPVA Grade A, plain sliced (flat cut), with book match between leaves of veneer, center balance match of spliced veneer leaves assembled on door or panel face.
1. Vertical Edges: Same species as face veneer.

B. Facing Adhesive: Type I - waterproof.

2.5 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
2. Provide solid blocking for other throughbolted hardware.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

F. Provide edge clearances in accordance with the quality standard specified.

2.6 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
1. Transparent:

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a. System - 5, Varnish, Conversion.
b. Stain: As selected by Architect from manufacturer's full range.
c. Sheen: Satin.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

2.7 ACCESSORIES

A. Hollow Metal Door Frames: See Section 081113.

B. Door Window Frames: Door window frames with glazing securely fastened within door opening.

C. Glazing: See Section 088000.

D. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

E. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.3 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

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3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 081416

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SECTION 083100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall- and ceiling-mounted access units.

1.2 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies

B. Section 093000 - Tiling

1.3 REFERENCE STANDARDS

A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

C. UL (FRD) - Fire Resistance Directory.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Project Record Documents: Record actual locations of each access unit.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years experience.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:
   1. Location: As indicated on drawings.

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2. Panel Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
3. Size: 24 by 24 inches unless indicated otherwise on drawings, but in no case smaller than 12 by 12 inches.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
7. Masonry Mounting Criteria: Provide surface-mounted frame with door surface flush with frame surface.

B. Wall-Mounted Units in Wet Areas:
1. Location: As indicated on drawings.
2. Panel Material: Stainless steel, Type 304.
3. Size: 24 by 24 inches unless indicated otherwise on drawings, but in no case smaller than 12 by 12 inches.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
6. Tile Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
7. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.

C. Fire-Rated Wall-Mounted Units:
1. Location: As indicated on drawings.
2. Wall Fire-Rating: As indicated on drawings.
3. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
4. Size: 24 by 24 inches unless indicated otherwise on drawings, but in no case smaller than 12 by 12 inches.
5. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

D. Ceiling-Mounted Units:
1. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
3. Size - Other Ceilings: 12 by 12 inches unless indicated otherwise on drawings, but in no case smaller than 12 by 12 inches.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

E. Fire-Rated Ceiling-Mounted Units:
1. Location: As indicated on drawings.
2. Ceiling Fire-Rating: As indicated on drawings.
3. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
4. Size: 12 by 12 inches unless indicated otherwise on drawings, but in no case smaller than 12 by 12 inches.

2.2 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

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1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
2. Babcock-Davis: www.babcockdavis.com.
3. Best Access Doors: www.bestaccessdoors.com.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Style: Exposed frame with door surface flush with frame surface.
a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
2. Door Style: Single thickness with rolled or turned in edges.
3. Heavy-Duty Frames: 14-gauge, 0.0747-inch minimum thickness.
4. Heavy-Duty Single Steel Sheet Door Panels: 14-gauge, 0.0747-inch minimum thickness.
5. Double-Skinned Hollow Steel Sheet Door Panels: 14-gauge, 0.0747-inch minimum thickness, on both sides and along each edge.
6. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
a. Provide products listed by UL (FRD) as suitable for purpose indicated.
b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
7. Hardware:
a. Hardware for Fire-Rated Units: As required for listing.
b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

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D. Set fire-rated access doors at locations and elevations indicated and in accord with NFPA 80.

E. Field paint access doors and panels in accord with requirements of 099123 - Interior Painting. Color shall match adjacent surfaces.

3.4 TESTING

A. Test and adjust hardware for ease of operation.

3.5 PROTECTION

A. Protect surfaces from damage or staining. Clean surfaces prior to Date of Substantial Completion.

END OF SECTION 083100

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SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.2 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware: Hardware items other than specified in this section.

B. Section 088000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

D. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

E. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

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G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.
   3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.

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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 change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCK-UPS

A. Locate where directed.

B. Mock-up may remain as part of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.9 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Provide five year manufacturer warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

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A. Center-Set Style, Thermally-Broken:
   1. Basis of Design: Kawneer North America; TriFab VersaGlaze 451T: www:kawneer.com.
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
   1. Oldcastle Building Envelope: www.obe.com
   2. YKK AP America, Inc.: www.ykkap.com.

2.2 BASIS OF DESIGN -- SWINGING DOORS

A. Medium Stile, Insulating Glazing, Thermally-Broken:
   1. Basis of Design: Kawneer North America; 350T Entrance Doors; www.kawneer.com.
   2. Thickness: 1-3/4 inches.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
   1. Oldcastle Building Envelope: www.obe.com.
   2. YKK AP America, Inc.: www.ykkap.com.

2.3 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Rabbet: For 1 inch insulating glazing.
   2. Glazing Position: Centered (front to back).
   3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep
   4. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

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11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.4 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. Glazing: See Section 088000.
1. For Exterior Framing: Type as indicated on the drawings.

C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches.
2. Top Rail: 3-1/2 inches wide.
3. Vertical Stiles: 3-1/2 inches wide.
4. Bottom Rail: 10 inches wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

2.5 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

D. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

E. Sealant for Setting Thresholds: Non-curing butyl type.

F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

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G. Glazing Accessories: See Section 088000.

2.6 FINISHES

A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

B. Color: As selected by Architect from manufacturer's standard range.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.7 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 087100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Install wall system in accordance with manufacturer's instructions.
2. Do not install damaged components.
3. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
4. Provide alignment attachments and shims to permanently fasten system to building structure.
5. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
6. Fit joints to produce hairline joints free of burrs and distortion.
7. Rigidly secure nonmovement joints.
8. Provide thermal isolation where components penetrate or disrupt building insulation.

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9. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
10. Install components plumb and true in alignment with established lines and grades.
11. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

B. Metal Protection:
1. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
2. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
3. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Sill Members:
1. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
2. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 - Joint Sealants to produce weathertight installation.
3. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

D. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

E. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Set thresholds in bed of sealant and secure.

G. Install glass using glazing method required to achieve performance criteria; see Section 088000.

H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.

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c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
d. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
e. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
1. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
a. Perform a minimum of two tests in each designated area as directed by Architect.
b. Conduct tests in each area prior to 10 percent and 35 percent completion of this work.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.6 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 084313

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SECTION 085653 - SECURITY WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Security transaction windows with pass-through device.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 092116 - Gypsum Board Assemblies: Bullet-resistant sheathing and wallboard for bullet-resistant partitions and walls.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

C. SSPC-Paint 33 - Coal Tar Mastic Coating, Cold-Applied.

D. UL 752 - Standard for Bullet-Resisting Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Furnish anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, to be embedded into concrete or masonry, with setting diagrams and installation, to applicable installer in time for installation.

B. Preinstallation Meeting: Prior to start of installation arrange a meeting on site to familiarize installer and installers of related work with requirements relating to this work.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's published data showing materials, construction details, dimensions of components, and finishes.

C. Shop Drawings: Drawings prepared specifically for this project, showing plans, elevations, sections, details of construction, anchorage to other work, hardware, and glazing.
   1. For new work show required opening dimensions and allowance for field deviation.

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D. Test Reports: Test reports for specific window model and glazing to be furnished, showing compliance with specified requirements; window and glazing may be tested separately, provided window test sample adequately simulates the glazing to be used.
   1. Include testing agency qualifications.
   2. For structural, forced entry, and ballistic tests, provide details on method of anchorage to test frame.

E. Coordination Drawings: For each window opening, show locations and details of items necessary to anchor windows that must be installed by others, in sufficient detail that installer of those items can do so correctly without reference to the actual window itself.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.
   2. Extra Security Fasteners: At least one box for every 50 boxes, or fraction thereof, of each type and size installed; provide products matching those installed, packaged and labeled.
   3. Tool Kit: 6 sets of tools for security fasteners.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with at least 5 years experience in the manufacture of windows of the type specified and able to provide test reports showing that their standard manufactured products meet the specified requirements; custom designed products not acceptable.

B. Testing Agency Qualifications: Independent testing agency able to show experience in conducting tests of the type specified and:
   1. Qualified according to ASTM E329 for testing tool-resisting steel.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

D. Welder Qualifications: Qualified in accordance with AWS procedures for type of welding required.

1.7 WARRANTY

A. See Section 017700 - Closeout Procedures for additional warranty requirements.

B. Provide manufacturer's warranty agreeing to repair or replace windows and window components that fail within three years after Date of Substantial Completion due to, but not limited to, the following:
   1. Structural failure, failure of welds, and deterioration of metals and finishes beyond that expected under detention use and normal weathering.
   2. Failure of glazing due to excessive deflection of supporting members under wind load.

PART 2 PRODUCTS

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2.1 MANUFACTURERS

A. Security Transaction Windows with Pass-Through Device:
   1. Basis of Design: Total Security Solutions: www.tssbulletproff.com.
   2. Substitutions: See Section 016000 - Product Requirements.

2.2 ASSEMBLIES

A. Security and Detention Windows:
   1. Dimensions, profiles, features, and performance specified and indicated on drawings are required; do not deviate unless specifically approved by Architect under substitution procedures; see Section 016000.
   2. Design to fit openings indicated on drawings; design to accommodate deviation of actual construction from dimensions indicated on drawings.
   3. Fabricate frames and sash with corners mitered or coped full depth with concealed welded joints.
   4. Design anchorages to provide performance equivalent to that required for window unit; provide anchorages at least equivalent to those by which the tested units were anchored to the test frame.
   5. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.
   6. Weld components before finishing and in concealed locations, to greatest extent possible; minimize distortion and discoloration of finish; remove residue of welding; grind exposed welds smooth and finish to match.
   7. Label units to indicate which side is which, such as inside/outside or secure/non-secure; use labels that are removable after installation but durable enough not to be lost during delivery, storage, handling, and installation.

2.3 SECURITY TRANSACTION WINDOWS WITH PASS-THROUGH DEVICE

A. Security Transaction Windows with Pass-Though Device:
   1. Location: Built within interior wall, as indicated on drawings.
   2. Type of Use: Walk-up.
   3. Ballistic Resistance: Tested to meet UL 752, Level 7.
   4. Window Type: Fixed.
      a. Overall Window Frame Size: 60 inch wide by 60 inch high.
      b. Frame Material: Stainless steel.
   5. Glazing: Single (monolithic), clear, and ballistic resistant.
   6. Pass-Through Device: Deal tray built into window sill.
      a. Material: Corrosion resistant.
   7. Communication: Offset glazing.
   8. Products:
      a. Basis of Design: Total Security Solutions; TW_BAFFLE: www.tssbulletproff.com..
      b. Substitutions: See Section 016000 - Product Requirements.

2.4 ASSEMBLY COMPONENTS

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A. Stainless Steel Framing: ASTM A666/A666M, Type 304; 14 gauge, 0.0781 inch minimum thickness.

B. Frame Anchors: Mild steel plates, shapes, or bars, concealed in completed construction; provide anchorage devices as necessary to securely fasten windows to adjacent construction; use security fasteners for exposed anchors.
   1. Provide minimum of two anchors per side of window plus one additional anchor for each 18 inches or fraction thereof more than 36 inches in height or width.

C. Glazing Seals: Factory installed; molded EPDM or neoprene compressible gaskets and compression strips.

D. Security Fasteners: Operable only by tools produced by fastener manufacturer or manufacturer's licensee; head style appropriate to installation conditions, strength, and finish of materials being fastened; use countersunk heads wherever possible.
   1. Drive System: Use not more than one of the following:
      a. 5-lobe Torx Plus socket head with security pin.
      b. Standard Torx socket head with security pin.
      c. Hex socket head with security pin.
      d. Phillips head with security pin.
      e. Two-hole drilled spanner head.
      f. Notched spanner head.
      g. One-way screw head.

E. Deal Trays: Formed stainless steel, recessed into counter or sill for mounting under glazing frame.
   1. Style: Plain curved recess with exposed flanges for flush mounting in counter or sill.
   2. Clear Opening Height: 1-1/2 inches.
   3. Tray Dimensions: 12 by 8 inches, wide by deep.

F. Bituminous Paint: Cold-applied asbestos-free asphalt mastic, complying with SSPC-Paint 33; 30 mils, 0.030 inch minimum thickness per coat.

G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.5 FINISHES

A. Polished Stainless Steel Finish:
   1. Polished as specified, without tool or die marks, stretch lines, or scratches, with grain running in long dimension of each piece.
   2. Passivated, rinsed, and chemically clean.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that window openings are ready for installation of windows.

B. Verify that correct embedded anchors are in place and in proper location; repair or replace anchors as required to achieve satisfactory installation.

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C. Notify Architect if conditions are not suitable for installation of windows; do not proceed until conditions are satisfactory.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and drawing details.

B. Install windows in correct orientation (inside/outside or secure/non-secure).

C. Anchor windows securely in manner so as to achieve performance specified.

D. Separate metal members from concrete and masonry using bituminous paint.

E. Set sill members and sill flashing in continuous bead of sealant.

3.3 ADJUSTING

A. Adjust operating components for smooth operation while also providing tight fit at contact points and a secure enclosure; lubricate operating hardware.

3.4 CLEANING

A. Clean exposed surfaces promptly after installation without damaging finishes.

B. Remove and replace defective work.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation and maintenance to designated Owner personnel.

END OF SECTION 085653

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SECTION 08 7100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. This Section includes the following:
1. Hinges
2. Continuous hinges
3. Key control system
4. Lock cylinders and keys
5. Lock and latch sets
6. Bolts
7. Exit devices
8. Push/Pull units
9. Closers
10. Overhead holders
11. Miscellaneous door control devices
12. Door trim units
13. Protection plates
14. Weatherstripping for exterior doors
15. Sound stripping for interior doors
16. Thresholds

C. Related Sections: The following Sections contain requirements that relate to this Section:
1. Section 01330: Submittals
2. Section 08110: Hollow Metal Doors
3. Section 08210: Wood Doors

D. Products furnished but not installed under this Section to include:
1. Cylinders for locks on entrance doors.
2. Final replacement cores and keys to be installed by Owner.

1.3 REFERENCES:

A. Standards of the following as referenced:
1. American National Standards Institute (ANSI)
2. Door and Hardware Institute (DHI)
3. Factory Mutual (FM)
4. National Fire Protection Association (NFPA)

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5. Underwriters' Laboratories, Inc. (UL)
   a. UL 10C - Fire Tests Door Assemblies
6. Warnock Hersey

B. Regulatory standards of the following as referenced:
1. Department of Justice, Office of the Attorney General, *Americans with Disabilities Act*, Public Law 101-336 (ADA).
2. CABO/ANSI A117.1: *Providing Accessibility and Usability for Physically Handicap People*, 1992 edition.

1.4 SYSTEM DESCRIPTION:

A. Refer to applicable “Headings“ for system description for electric and electro-pneumatic hardware products.

1.5 SUBMITTALS:

A. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. For items other than those scheduled in the “Headings” of Section 3, provide catalog information for the specified items and for those submitted.

B. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format “hardware sets" indicating complete designations of every item required for each door or opening. Use specification Heading numbers with any variations suffixed a, b, etc. Include the following information:
   a. Type, style, function, size, and finish of each hardware item.
   b. Name and manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of each hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
   e. Explanation of all abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for hardware.
   g. Door and frame sizes and materials.
   h. Keying information.
   i. Cross-reference numbers used within schedule deviating from those specified.
      1) Column 1: State specified item and manufacturer.
      2) Column 2: State prior approved substituted item and its manufacturer.
2. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.

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3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

C. Samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.

D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

E. Contract closeout submittals:
1. Operation and maintenance data: Complete information for installed door hardware.
2. Warranty: Completed and executed warranty forms.

1.6 QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC), or equivalent, who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
1. Require subcontractor and supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.
2. Require supplier to meet with installer prior to beginning of installation of door hardware.

C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not. All hardware shall comply with standards UBC 702 (1997) and UL 10C.
1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

1.7 PRODUCT HANDLING:

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A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.8 WARRANTY:

A. Special warranties:
1. Door Closers: Ten year period
2. Exit Devices: Three year period
3. Locksets: Three year period

1.9 MAINTENANCE:

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.

B. Parts kits: Furnish manufacturers' standard parts kits for locksets, exit devices, and door closers.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS:
(* Denotes manufacturer referenced in the Hardware Headings)

A. Butt Hinges:
1. Acceptable manufacturers:
a. Hager
b. Ives
c. PBB*
2. Characteristics:
a. Templates: Provide only template-produced units.
b. Screws: Provide Phillips flat-head screws complying with the following requirements:

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1) For metal doors and frames install machine screws into drilled and tapped holes.
2) For wood doors and frames install threaded-to-the-head wood screws.
3) For fire-rated wood doors install #12 x 1-1/4 inch, threaded-to-the-head steel wood screws.
4) Finish screw heads to match surface of hinges or pivots.

c. Hinge pins: Except as otherwise indicated, provide hinge pins as follows:
1) Out-Swing Exterior Doors: Non-removable pins.
2) Out-Swing Corridor Doors with Locks: Non-removable pins.
3) Interior Doors: Non-rising pins.
4) Tips: Flat button and matching plug. Finished to match leafs.

d. Size: Size hinges in accordance with specified manufacturer's published recommendations.

e. Quantity: Furnish one pair of hinges for all doors up to 5'0" high. Furnish one hinge for each additional 2-1/2 feet or fraction thereof.

f. Hinges to be full mortised ball bearing hinges.

B. Continuous Hinges:
1. Acceptable manufacturers:
a. Markar
b. PBB
c. Select Products*
2. Characteristics:
a. Continuous gear hinges to be manufactured of extruded 6063-T6 aluminum alloy with anodized finish, or factory painted finish as scheduled.
b. All hinges are to be manufactured to template. Uncut hinges shall be non-handed and shall be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising.
c. Vertical door loads shall be carried on chemically lubricated polyacetal thrust bearings. The door and frame leaves shall be continually geared together for the entire hinge length and secured with a full cover channel. Hinge to operate to a full 180°.
d. Hinges to be milled then anodized and assembled in matching pairs. Fasteners supplied shall be 410 stainless steel, plated and hardened.
e. Provide UL listed continuous hinges at fire doors. Continuous hinges at fire doors (suffix -FR) shall meet the required ratings without the use of auxiliary fused pins or studs.

C. Cylinders:
1. Acceptable manufacturers:
a. Best* TO MATCH EXISTING
b. PDQ
c. Schlage
2. Characteristics:
a. Review the keying system with the Owner and provide the type required, integrated with Owner's existing Best patented system.

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b. Furnish final cores and keys for installation by Owner.
c. Equip locksets with Best small format, 7-pin, interchangeable core (SFIC) compatible with Owners existing system. Furnish temporary inserts for the construction period and remove when directed.
d. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
e. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
    1) Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, “DO NOT DUPLICATE."
f. Key Material: Provide keys of nickel silver only.
g. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, 5 grandmaster keys for each grandmaster system, and 2 construction master keys.
    1) Furnish one extra blank for each lock.
    2) Deliver keys to Owner.

D. Locksets, Latchsets, Deadbolts:
1. Acceptable manufacturers:
    a. Best 40H*
    b. PDQ MR series
    c. Schlage L9000 series
    d.
2. Heavy Duty Mortise Locks and Latches: as scheduled.
    a. All locksets shall be full mortised with lever handles.
    b. Thumbturns: Accessible design not requiring pinching or twisting motion to operate.
    c. Deadbolts: Stainless steel, 1” throw.
    d. Lever Trim: accessible design, independent operation, minimum 2" clearance from lever mid-point to door face.
    e. Latch: solid 3/4” throw and stainless steel antifriction.
    f. Strikes: 16 gauge curved stainless steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
    g. Lock Series and Design: 40H series, 14H lever or Schlage equivalent.
    h. Certifications:
        1) ANSI A156.13, Series 1000, Operational Grade 1.
        2) UL listed for A label single doors up to 4 ft x 8 ft.

E. Exit Devices:
1. Acceptable manufacturers:
    a. PDQ
    b. Sargent
    c. Von Duprin CD98/35 series*Characteristics:
    d. Exit devices shall be "UL" listed for life safety. All exit devices for fire rated openings shall have “UL" labels for “Fire Exit Hardware."
    e. All exit devices mounted on labeled wood doors shall be mounted on the door per the door manufacturer’s requirements.

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f. All trim shall be thru-bolted to the lock stile case.
g. All exit devices shall be made of brass, bronze, stainless steel, or aluminum material, powder coated, anodized, or plated to the standard architectural finishes to match the balance of the door hardware.
h. Provide glass bead conversion kits to shim exit devices on doors with raised glass heads.
i. All exit devices shall be one manufacturer. No deviation will be considered.
j. All exit devices shall be non-handed. Touchpad shall extend a minimum of 1/2 of the door width and shall extend to the height of the cross rail housing for a "no pinch" operation. Plastic touchpads are not acceptable. All latchbolts to be the deadlocking type. Latchbolts shall have a self-lubricating coating to reduce wear. Plated or plastic coated latchbolts are not acceptable. Plastic linkage and "dogging" components are not acceptable.\
k. Rim devices must be keyed with a removable mullion.
l. Surface vertical rod devices shall be UL labeled for fire door applications without the use of bottom rod assemblies. Where bottom rods are required for security applications, the devices shall be UL labeled for fire doors applications with rod and latch guards by the device manufacturer.

F. Closers and Door Control Devices:
1. Acceptable manufacturers:
a. LCN 4040 series
b. PDQ 7100 series
c. Sargent 250 series
2. Characteristics:
a. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder and through bolted to door.
b. All closers shall utilize a stable fluid withstanding 120 degree F to -30 F range without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.
c. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed and back check.
d. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.
e. Closers must be through bolted on hollow metal and wood doors.
f. Concealed closers and floor closers are not acceptable.
g. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors shall provide for corridor clear width as required by code. Where possible, mount closers inside rooms.

G. Power Operators:

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1. Acceptable manufacturers:
   a. Horton
   b. LCN
   c. SDC
2. Characteristics:
   a. Unit to be non-handed to be mounted in either in-swinging or out-swinging installations.
   b. Unit to be factory assembled, adjusted and tested.
   c. Operating equipment will utilize a d.c. motor and helical gears for quiet operation.
   d. Equipment shall only meet the requirements of the American National Standard for ANSI/BHMA A156.19-2002 Standard for Low Energy Power Operated Doors.
   e. System to be capable of operating between -40°F and 140°F.
   f. Door closing shall be by spring force and monitored by the microprocessor control, capable of providing limited power assist to insure the door closes.
   g. The operator housing shall be 5" (127mm) deep by 4-1/2" (114mm) high, by the width of the door panels (s) plus 3" (76mm). Mounting plate shall provide cable access at both ends.
   h. Full length pairs to be supplied with extended housing and manual closer on non-ADA door leaf.
   i. Door activating and holding controls shall be by actuators or motion sensors, unless the “Push to start” application is being employed. The actuators may be hard wired or wireless rf as required. Specified actuators are BEA jamb mount and wall mount.
   j. Equipment designed to handle swing doors with weights up to 250 lbs (113kg).
   k. Opening speed to fully open shall be adjusted as required in ANSI/BHMA A156.19-2002 low energy doors. Field adjustable to remain open for not less than 5 seconds for low energy doors.
   l. Field adjustable to close from 90° to 10° as required in ANSI/BHMA A156.19-2002 low energy doors, depending on final door weight. Doors shall close from 10° to fully closed in not less than 1.5 seconds. The force required to prevent a stopped door from opening in the last 10° of opening, or at any point in closing shall not exceed 40 lbs (133N) applied 1" (25mm) from the latch edge of the door.
   m. In the event of a power failure, doors shall open with manual pressure not to exceed 30 lbs (133N) at a point 1" (25mm) from the latch edge of the door.
   n. Microprocessor controls shall be field adjustable to comply with ANSI/BHMA A156.19-2002 Standard for Low Energy Power Operated Doors; on board programmer included.
   o. Field adjustments for the door opening speed, door opening force, door closing speed, and door closing force shall be standard within the unit and adjust independently from all other external requirements.
   p. Unit will provide the ability to determine the diagnostic evaluation of problematic issues through a digitized display panel. The display will provide confirmation that the door is performing properly and also provide error codes when it is not. The panel shall provide systematic

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information such as counters for usage determination, and provide the installing contractor's telephone number in the event of service requirements.

q. Doors must be equipped with a sign(s) visible from either side, instructing the user as to the operation and function of the door: AUTOMATIC PUSH SWITCH TO OPEN.

r. Installation of the automatic door operators shall be done by a trained installer skilled in the installation of automatic door operators and equipment. Factory training provided by the operator manufacturer is recommended. All low voltage switch hookups are the responsibility of the operator installer, as well as temporary wiring hookup to plug into wall outlet for test of system. Final hookup of 115VAC power will be handled by and coordinated with the general contractor's electrical contractor.

s. Upon completion of work, installer is to apply a sticker to the operator header case which illustrates the installer's name, address and phone number.

H. Overhead Door Holders:

1. Acceptable manufacturers:
   a. ABH*
   b. Glynn Johnson
   c. Rixson Firemark
2. Characteristics:
   a. Provide heavy duty door holders (concealed and surface mounted) of stainless steel.
   b. Concealed holders to be installed with the jamb bracket mortised flush with the bottom of the jamb. The arm and channel to be mortised into the door.
   c. Surface holders to be installed with the jamb bracket mounted on the stop.

I. Floor Stops and Wall Bumpers:

1. Acceptable manufacturers:
   a. Burns*
   b. Rockwood
   c. Trimco
2. Characteristics: Refer to Hardware Headings.

J. Door Bolts/Coordinators:

1. Acceptable manufacturers:
   a. Burns*
   b. Rockwood
   c. Trimco
2. Characteristics:
   a. Flush bolts to be forged brass 6-3/4" x 1", with 1/2" diameter bolts. Plunger to be supplied with milled surface one side that fits into a matching guide.

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b. Automatic flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
c. Self latching flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
d. Automatic flush bolts and self-latching flush bolts shall be UL listed for fire door application without bottom bolts (LBB).
e. Coordinator to be soffit mounted non-handed fully automatic UL listed coordinating device for sequential closing of paired doors with or without astragals.
f. Provide filler pieced to close the header. Provide brackets as required for mounting of soffit applied hardware.

K. Protective Plates:
1. Acceptable manufacturers:
a. Burns*
b. Rockwood
c. Trimco
2. Characteristics:
a. Provide manufacturers standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
b. Materials:
1) Metal Plates: Stainless Steel, .050 inch (U.S. 18 gage).
c. Fabricate protection plates not more than 2 inches less than door width on hinge side and not more than 1 inch less than door width on pull side.
d. Heights:
1) Kick plates to be 10 inches in height.
2) Mop plates to be 4 inches in height.
3) Armor plates to be 36 inches in height. Armor plates on fire doors to comply with NFPA 80.

L. Thresholds:
1. Acceptable manufacturers:
a. National Guard Products, Inc.*
b. Reese Industries
c. Zero Weatherstripping Co., Inc.
2. Types: Indicated in Hardware Headings.

M. Door Seals/Gasketing:
1. Acceptable manufacturers:
a. National Guard Products, Inc.*
b. Reese Industries
c. Zero Weatherstripping Co., Inc.
2. Types: Indicated in Hardware Headings.

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N. Silencers:
1. Acceptable manufacturers:
a. Burns*
b. Hager
c. Rockwood
2. Three for each single doors; four for pairs of doors.

O. Security Equipment:
1. Acceptable manufacturers:
a. Dynalock
b. Security Door Controls*
c. Von Duprin
2. Characteristics:
a. Provide items as found in Hardware Headings.
3. Coordinate security equipment with Electrical.

2.2 MATERIALS AND FABRICATION:

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
1. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
2. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including “prepared for paint" surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.

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4. Do not use thru-bolts or sex bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of adequately fastening the hardware, or otherwise found in Headings. Coordinate with wood doors and metal doors and frames where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.3 HARDWARE FINISHES:

A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch of lock sets).

B. Provide finishes that match those established by ANSI or, if none established, match the Architect's sample.

C. 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.

D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."

E. The designations used to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
1. Hinges (Exterior): 630 (US32D) Satin Stainless Steel
2. Hinges (Interior wood doors): 652 (US26D) Satin Chrome Plated Steel
3. Hinges (Interior metal doors): 600 (USP)
4. Continuous Hinges: 628 (US28) Clear Anodized Aluminum
5. Flush Bolts: 626 (US26D) Satin Chrome Plated Brass/Bronze
6. Locks: 626 (US26D) Satin Chrome Plated Brass/Bronze
7. Exit Devices: 630 (US32D) touchpad, Balance to match adjacent hardware
8. Door Closers: Powder coat to match adjacent hardware
9. Protective Plates: 630 (US32D) Satin Stainless Steel
10. Door Stops: 626 (US26D) Satin Chrome Plated Brass/Bronze
11. Overhead Holders: 630 (US32D) Satin Stainless Steel
12. Thresholds/Weatherstripping: 627/628 (US27/US28) Aluminum

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

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2. "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute.
3. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section “Joint Sealers”.

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING:

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

C. Door Hardware Supplier's Field Service
1. Inspect door hardware items for correct installation and adjustment after complete installation of door hardware.
2. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
3. File written report of this inspection to Architect.

D. Prior to project completion, representatives of the lock, exit device and overhead closer manufacturers shall inspect and adjust all units and certify that all units are installed in accordance with the manufacturer’s instructions, and are regulated properly and functioning correctly. A written report shall be provided to the Architect as to the inspection and shall include appropriate certificates.

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3.3 HARDWARE SCHEDULE:

HEADING #A1

DOORS #: 100A

EACH PAIR TO HAVE:

2	CONTINUOUS HINGES	SL11HD
1	EXIT DEVICE	3547NL-OP
1	EXIT DEVICE	3547EO
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
2	DOOR PULLS	VP4252 x 9 MTG.
2	CLOSERS	7101 x DSHO x PLATES/BRACKETS AS REQ.
1	THRESHOLD	425E
1	SET DOOR SEALS	BY FRAME MANUFACTURER
2	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER
1	ASTRAGAL SET	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME.

HEADING #A2

DOORS #: 101A

EACH PAIR TO HAVE:

2	CONTINUOUS HINGES	SL11HD
2	PUSH/PULL SETS	VP4242 x VP4252 x 5/9 MTG.
2	CLOSERS	7101 x DSHO x PLATES/BRACKETS AS REQ.

NOTE: FINISH TO MATCH DOOR/FRAME.

HEADING #A3

DOORS #: 101B, 101D

EACH PAIR TO HAVE:

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2	CONTINUOUS HINGES	SL11HD x ATW8
1	EXIT DEVICE	QEL3547L-F x REX
1	EXIT DEVICE	3547L-F x REX
2	CYLINDERS	TO MATCH EXISTING BEST SYSTEM
1	ACCESS CONTROL READER	BY SECURITY SYSTEM PROVIDER
1	POWER SUPPLY	PS900 SERIES
2	CLOSERS	7101 x DS x PLATES/BRACKETS AS REQ.
1	SET DOOR SEALS	BY FRAME MANUFACTURER
2	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER
1	ASTRAGAL SET	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME. COORIDNATE SECURITY HARDWARE WITH SECURITY AND ELECTRICAL SYSTEMS.

HEADING #A4

DOORS #: 101C

EACH DOOR TO HAVE:

1	CONTINUOUS HINGE	SL11HD
1	LOCKSET	AR4910 x 4568
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
1	ELECTRIC STRIKE	55ABC
1	ACCESS CONTROL READER	BY SECURITY SYSTEM PROVIDER
1	POWER SUPPLY	602RF SERIES
1	CLOSER	7101 x DS x PLATES/BRACKETS AS REQ.
1	SET DOOR SEALS	BY FRAME MANUFACTURER
1	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME. COORIDNATE SECURITY HARDWARE WITH SECURITY AND ELECTRICAL SYSTEMS.

HEADING #A5

DOORS #: 102, 143F, 144

EACH DOOR TO HAVE:

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1	CONTINUOUS HINGE	SL11HD
1	EXIT DEVICE	3547NL-OP
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
1	DOOR PULL	VP4252 x 9 MTG.
1	CLOSER	7101 x DSHO x PLATES/BRACKETS AS REQ.
1	THRESHOLD	425E
1	SET DOOR SEALS	BY FRAME MANUFACTURER
1	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME.

HEADING #A6

DOORS #: 143A

EACH DOOR TO HAVE:

1	CONTINUOUS HINGE	SL11HD
1	LOCKSET	AR4910 x 4568
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
1	CLOSER	7101 x DSHO x PLATES/BRACKETS AS REQ.
1	SET DOOR SEALS	BY FRAME MANUFACTURER
1	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME.

HEADING #A7

DOORS #: 143C

EACH DOOR TO HAVE:

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1	CONTINUOUS HINGE	SL11HD
1	LOCKSET	AR4910 x 4568
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
1	ELECTRIC STRIKE	55ABC
1	ACCESS CONTROL READER	BY SECURITY SYSTEM PROVIDER
1	POWER SUPPLY	602RF SERIES
1	CLOSER	7101 x DSHO x PLATES/BRACKETS AS REQ.
1	SET DOOR SEALS	BY FRAME MANUFACTURER
1	DOOR BOTTOM SEALS	BY DOOR MANUFACTURER

NOTE: FINISH TO MATCH DOOR/FRAME. COORIDNATE SECURITY HARDWARE WITH SECURITY AND ELECTRICAL SYSTEMS.

HEADING #1

DOORS #: 105, 140

EACH DOOR TO HAVE:

3	HINGES	4B81
1	LOCKSET	45H7D
1	ELECTRIC STRIKE	55ABC
1	ACCESS CONTROL READER	BY SECURITY SYSTEM PROVIDER
1	POWER SUPPLY	602RF
1	CLOSER	7101 x RA
1	KICK PLATE	KP50 x B4E
1	DOOR STOP	565/522 (AS REQ.)

NOTE: COORDINATE SECURITY HARDWARE WITH SECURITY AND ELECTRICAL SYSTEMS. EXISTING DOOR TO REMAIN. COORDINATE NEW HARDWARE WITH EXISTING DOOR PREPS.

HEADING #2

DOORS #: 110, 111, 241, 242

EACH DOOR TO HAVE:

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3	HINGES	4B81
1	PRIVACY SET-IND	45H0VIS
1	CLOSER	7101 x PA (@ 110, 111)
1	CLOSER	7101 x RA (@ 241, 242)
1	KICK PLATE	KP50 x B4E
1	DOOR STOP	565/522 (AS REQ.)
1	SET DOOR SEALS	5050
1	COAT HOOK	604

HEADING #3

DOORS #: 112, 115, 239, 240, 243, 244, 245, 247, 248, 251, 252, 253, 254, 255, 256, 257, 258

EACH DOOR TO HAVE:

3	HINGES	BB81
1	LOCKSET-OFFICE	45H7AT
1	DOOR STOP	565/522 (AS REQ.)
1	SET DOOR SEALS	5050
1	COAT HOOK	604

NOTE: COORDINATE NEW HARDWARE WITH EXISTING DOOR PREPS @ 112 IF DOOR IS RETAINED.

HEADING #4

DOORS #: 127

EACH DOOR TO HAVE:

3	HINGES	4B81
1	EXIT DEVICE	98L-F
1	CYLINDER	TO MATCH EXISTING BEST SYSTEM
1	CLOSER	7101 x PA
1	KICK PLATE	KP50 x B4E
1	DOOR STOP	565/522 (AS REQ.)
1	SET DOOR SEALS	5075

HEADING #5

DOORS #: 139, 237, 238

EACH DOOR TO HAVE:

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3		HINGES	BB81
1		PASSAGE SET	45H0N
	1	DOOR STOP	565/522 (AS REQ.)
	1	SET DOOR SEALS	5050

HEADING #6

DOORS #: 141

EACH DOOR TO HAVE:

3		HINGES	4B51 x NRP
1		LOCKSET-STOREROOM	45H7D
1		CYLINDER	TO MATCH NEW SYSTEM
1		CLOSER	7101 x DSHO
1		KICK PLATE	KP50 x B4E
	1	THRESHOLD	425E
	1	SET DOOR SEALS	169U
	1	DOOR BOTTOM SEAL	200N
	1	DRIP CAP	17
	1	LATCHGUARD	620

HEADING #7

DOORS #: 142

EACH PAIR TO HAVE:

6		HINGES	4B81
1		SET FLUSHBOLTS	591 x 545 (INACTIVE)
1		LOCKSET	45H7R (ACTIVE)
2		KICK PLATES	KP50 x B4E
	2	DOOR STOPS	565/522 (AS REQ.)

HEADING #8

DOORS #: 143B

EACH PAIR TO HAVE:

ALPHA SPEC SET 09-10-2026

6	HINGES	4B81
2	EXIT DEVICES	98L
2	CYLINDERS	TO MATCH EXISTING BEST SYSTEM
2	CLOSERS	7101 x DSHO
2	KICK PLATES	KP50 x B4E
1	SET DOOR SEALS	5050
1	DOOR EDGE SEAL	5070

HEADING #9

DOORS #: 143D

EACH DOOR TO HAVE:

3	HINGES	4B81
1	LOCKSET	45H7D
1	ELECTRIC STRIKE	55ABC
1	ACCESS CONTROL READER	BY SECURITY SYSTEM PROVIDER
1	POWER SUPPLY	602RF
1	CLOSER	7101 x RA
1	KICK PLATE	KP50 x B4E
1	DOOR STOP	565/522 (AS REQ.)
1	SET DOOR SEALS	5075

NOTE: COORDINATE SECURITY HARDWARE WITH SECURITY AND ELECTRICAL SYSTEMS.

HEADING #10

DOORS #: 145, 146

EACH DOOR TO HAVE:

1	CONTINUOUS HINGES	SL24HD
1	PUSH/PULL SET	74L x 5426C x 12 MTG.
1	CLOSER	7101 x DSHO
1	KICK PLATE	KP50 x B4E

HEADING #11

DOORS #: 249

EACH DOOR TO HAVE:

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3	HINGES	BB81
1	LOCKSET-CLASSROOM	45H7R
1	CLOSER	7101 x RA
1	KICK PLATE	KP50 x B4E
1	DOOR STOP	565/522 (AS REQ.)
1	SET DOOR SEALS	5075

HEADING #12

DOORS #: 250, 259

EACH DOOR TO HAVE:

3	HINGES	BB81
1	LOCKSET-CLASSROOM	45H7R
1	DOOR STOP	565/522 (AS REQ.)

END OF SECTION

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SECTION 088000 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Fire-protection-rated glazing units

D. Glazing compounds.

1.2 RELATED REQUIREMENTS

A. Section 072700 - Air Barriers.

B. Section 079200 - Joint Sealants: Sealants for other than glazing purposes.

C. Section 081213 - Hollow Metal Frames: Glazed borrowed lites.

D. Section 081416 - Flush Wood Doors: Glazed lites in doors.

E. Section 084313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

E. ASTM C1036 - Standard Specification for Flat Glass.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants.

H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.

I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

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K. BS EN 14179-1 - Glass in Building - Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass - Part 1: Definition and Description.

L. GANA (SM) - GANA Sealant Manual.

M. ICC (IBC) - International Building Code.

N. ITS (DIR) - Directory of Listed Products.

O. NFRC 100 - Procedure for Determining Fenestration Product U-factors.

P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

R. UL (DIR) - Online Certifications Directory.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).
      b. Safety Glazing Certification Council (SGCC).

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.6 MOCK-UPS

A. Provide on-site glazing mock-up with the specified glazing components.

B. Locate where directed.

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C. Mock-ups may remain as part of the Work.

1.7 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

B. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Glass Fabricators:
1. GGI - General Glass International: www.generalglass.com.
2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.
3. Viracon, Inc: www.viracon.com.
4. Substitutions: See Section 016000 - Product Requirements.

B. Float Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com.
2. Guardian Glass, LLC: www.guardianglass.com.
3. Saint Gobain North America: www.saint-gobain.com.
4. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com.
5. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
1. Design Pressure: : Refer to Structural Drawings for design load criteria. Develop actual wind loads in accordance with applicable Building Code
2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.

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1. In conjunction with weather barrier related materials described in other sections, as follows:
   a. Air Barriers: See Section 072700.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with BS EN 14179-1.
6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
1. Basis of Design: Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
3. Guardian Glass, LLC: www.guardianglass.com/#sle.
4. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc: www.pilkington.com/na/#sle.
5. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.

B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Aluminum.
5. Edge Seal:

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a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
b. Color: Black.

6. Purge interpane space with dry air, hermetically sealed.

C. Type G-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with argon.
3. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
a. Tint: Clear.
b. Coating: Low-E (passive type), on #2 surface.
1) Basis of Design: Vitro Architectural Glass (formerly PPG Glass); Solarban 70: www.vitroglazings.com/#sle.
4. Warm-edge spacer.
5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
a. Tint: Clear.
6. Total Thickness: 1 inch.
7. Color: Black.
8. Purge interpane space with dry air, hermetically sealed.
9. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.28, nominal.
10. Visible Light Transmittance (VLT): 64 percent, nominal.
11. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
12. Visible Light Reflectance, Outside: 13 percent, nominal.
13. Glazing Method: Dry glazing method, gasket glazing.

D. Type G-2 - Insulating Glass Units: Safety glazing.
1. Applications:
a. Glazed lites in exterior doors.
b. Glazed sidelights and panels next to doors.
c. Other locations required by applicable federal, state, and local codes and regulations.
d. Other locations indicated on drawings.
2. Space between lites filled with argon.
3. Glass Type: Same as Type G1 except use fully tempered float glass for both outboard and inboard lites.
4. Total Thickness: 1 inch.
5. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.
7. Warm-edge spacer.
8. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.28, nominal.
9. Visible Light Transmittance (VLT): 64 percent, nominal.
10. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
11. Visible Light Reflectance, Outside: 13 percent, nominal.
12. Glazing Method: Dry glazing method, gasket glazing.

2.5 GLAZING UNITS

A. Type G-3 - Monolithic Safety Glazing: Non-fire-rated.

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1. Applications:
   a. Glazed lites in interior doors.
   b. Glazed sidelights to doors, except in fire-rated walls and partitions.
   c. Other locations required by applicable federal, state, and local codes and regulations.
   d. Other locations indicated on drawings.
2. Glass Type: Fully tempered safety glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.

2.6 FIRE-PROTECTION-RATED GLAZING UNITS

A. Type G-4 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flames, smoke, and blocks radiant heat, as required to achieve indicated fire rating period exceeding 45 minutes.
   1. Applications:
      a. Glazing in fire-rated door assembly.
   2. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
   3. Provide products listed by UL (DIR) and approved by authorities having jurisdiction.
   4. Safety Glazing Certification: 16 CFR 1201 Category II.
   5. Glazing Method: As required for fire rating.
   6. Fire Rating Period: 60 minutes.
   7. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
   8. Products:
      a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XLM 60: www.safti.com.
      b. Technical Glass Products; Pilkington Pyrostop 60: www.fireglass.com.
      c. Vetrotech North America; Contraflam 60: www.vetrotechusa.com.
      d. Substitutions: See Section 016000 - Product Requirements.

2.7 GLAZING COMPOUNDS

A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.

B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

C. Manufacturers:
   1. Dow Corning Corporation: www.dowcorning.com/construction.
   2. Pecora Corporation: www.pecora.com/#sle.
   3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.8 ACCESSORIES

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A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Thickness: As required for application.
   2. Spacer Rod Diameter: As required for application.
   3. Manufacturers:
      a. Tremco Global Sealants: www.tremcosealants.com.
      b. Substitutions: See Section 016000 - Product Requirements.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

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A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.6 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 088000

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SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal stud wall framing.

B. Acoustic insulation.

C. Gypsum wallboard.

D. Joint treatment and accessories.

E. Acoustic Shielding.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Wood blocking product and execution requirements.

B. Section 072100 - Thermal Insulation: Acoustic insulation.

C. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

D. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.3 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

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I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

J. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.

N. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels.

O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

P. GA-216 - Application and Finishing of Gypsum Panel Products.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data:
1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

PART 2 PRODUCTS

2.1 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: www.clarkdietrich.com.
2. Marino: www.marinoware.com.
3. SCAFCO Corporation: www.scafco.com.
4. Substitutions: See Section 016000 - Product Requirements.

C. All framing members to be from one manufacturer.

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D. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. **Minimum 20ga (0.76 mm / 30 mil) actual member thickness;** 20ga "equivalent" member thickness is not acceptable.
   2. Studs: C-shaped.
      a. Products:
         1) Basis of Design: ClarkDietrich; ProSTUD 30mil Drywall Stud: www.clarkdietrich.com.
   3. Runners: U shaped, sized to match studs.
   4. Ceiling Channels: C-shaped.
   5. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

F. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.

G. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Main Tees: 16ga C-shaped Channels.
   2. Support Bars: 16ga Furring Channels.
   3. Accessories: Metal furring channel clips.
   4. Products:
      a. Basis of Design Manufacturer: ClarkDietrich: www.clarkdietrich.com.

2.2 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation: www.certainteed.com.
   2. Georgia-Pacific Gypsum: www.gpgypsum.com.
   3. National Gypsum Company: www.nationalgypsum.com.
   4. USG Corporation: www.usg.com.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

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3. Thickness:
   a. Vertical Surfaces: 5/8 inch.
   b. Ceilings: 5/8 inch.
4. Paper-Faced Products for Rated Partitions:
   a. CertainTeed Corporation; Type X Gypsum Panel: www.certainteed.com.
   b. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gpgypsum.com.
   c. National Gypsum Company; Gold Bond Fire-Shield Gypsum Board: www.nationalgypsum.com.
   d. USG Corporation; USG Sheetrock Brand Firecode X Panels: www.usg.com.
5. Paper-Faced Products for Non-Rated Partitions:
   a. CertainTeed Corporation; Certainteed Regular Gypsum Panel: www.certainteed.com.
   b. Georgia-Pacific Gypsum; ToughRock Lite-Weight Gypsum Board: www.gpgypsum.com.
   c. National Gypsum Company; Gold Bond Gypsum Board: www.nationalgypsum.com.
   d. USG Corporation; USG Sheetrock Brand Panels: www.usg.com.
6. Mold Resistant Paper Faced Products for Rated Partitions:
   a. CertainTeed Corporation; M2Tech Type X Gypsum Panel: www.certainteed.com.
   b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com.
   c. National Gypsum Company; Gold Bond XP Fire Shield Gypsum Board: www.nationalgypsum.com.
   d. USG Corporation; USG Sheetrock Brand EcoSmart Panels Mold Tough Firecode X: www.usg.com.
7. Mold Resistant Paper Faced Products for Non-Rated Partitions:
   a. CertainTeed Corporation; M2Tech Gypsum Panel: www.certainteed.com.
   b. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com.
   c. National Gypsum Company; Gold Bond XP Gypsum Board: www.nationalgypsum.com.
   d. USG Corporation; USG Sheetrock Brand EcoSmart Panels Mold Tough: www.usg.com.

2.3 GYPSUM BOARD ACCESSORIES

A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   2. Products:
      a. Approved by board material manufacturer.
   3. Joint Compound: Drying type, vinyl-based, ready-mixed.
      a. Products:
         1) Approved by board material manufacturer.

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C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

D. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.
1. Extend partition framing to structure in all locations.
2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 16 inches on center.
1. Orientation: Vertical.
2. Spacing: At 16 inches on center.

F. Blocking: Install wood blocking for support of:
1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

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B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

3.6 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with setting type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.7 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet, non-cumulative, in any direction.

END OF SECTION 092116

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SECTION 093000 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Stone thresholds.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section 093050 - Tile Trim and Accessories.

1.3 REFERENCE STANDARDS

A. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar.

B. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar.

C. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation.

D. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

E. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

F. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products.

G. ASTM C485 - Standard Test Method for Measuring Warpage of Ceramic Tile.

H. ASTM C499 - Standard Test Method for Facial Dimensions and Thickness of Flat, Rectangular Ceramic Wall and Floor Tile.

I. ASTM C648 - Standard Test Method for Breaking Strength of Ceramic Tile.

J. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation.

K. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

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1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

E. Installer's qualification statement.

F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Tile: Minimum 25 square feet of each size, color, and surface finish combination, in complete unopened carton(s).

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 TILE

A. Manufacturers:
1. Basis of Design: Dal-Tile Corporation: www.daltile.com

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2. American Olean Corporation: www.americanolean.com.
3. Florida Tile, Inc.: www.floridatile.com.
4. Dal-Tile Corporation: www.daltile.com.
5. Substitutions: See Section 016000 - Product Requirements.

B. Glazed Floor Tile, Type CT-1: ANSI A137.1 standard grade.
1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
2. Break Strength: 125lbf when tested in accordance with ASTM C648.
3. Thickness: 8.5 mm
4. Thickness Variation: Maximum 0.030 inch when tgested in accordance with ASTM C499.
5. Surface Hardness: 5 Mohs.
6. Warpage Edge: Conforms when tested in accordance with ASTM C485.
7. Warpage Diagonal: Conforms when tested in accordance with ASTM C485.
8. Size: 12 inch by 12 inch, nominal.
9. Edges: Square.
10. Surface Finish: Matte glaze.
11. Color: As selected by Architect from manufacturer's full range.
12. Products:
    a. Basis of Design: Dal-Tile Corporation; Memoir: www.daltile.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

C. Glazed Wall Tile, Type CT-2: ANSI A137.1 standard grade.
1. Moisture Absorption: 7.0 to 20.0 percent as tested in accordance with ASTM C373.
2. Break Strength: 125lbf when tested in accordance with ASTM C648.
3. Thickness: 8.5 mm
4. Thickness Variation: Maximum 0.030 inch when tgested in accordance with ASTM C499.
5. Surface Hardness: 5 Mohs.
6. Warpage Edge: Conforms when tested in accordance with ASTM C485.
7. Warpage Diagonal: Conforms when tested in accordance with ASTM C485.
8. Size: 4-1/4 by 4-1/4 inch, nominal.
9. Edges: Cushioned.
10. Surface Finish: High gloss.
11. Color: As selected by Architect from manufacturer's standard range.
12. Products:
    a. Basis of Design: Dal-Tile Corporation; Color Wheel Classic: www.daltile.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

2.2 TRIM AND ACCESSORIES

A. Tile trim as specified in Section 093050 - Tile Trim and Accessories.

B. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
1. Thickness: 1/2 inch.
2. Material: Marble, honed finish.
3. Applications:

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a. At doorways where tile terminates.

2.3 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, and water. ANSI A118.1
1. Products:
a. Basis of Design: Custom Building Products; CustomBlend Economical Non-Modified Thin-Set Mortar: www.custombuilding products.com.
b. LATICRETE International, Inc: www.laticrete.com.
c. Merkrete, by Parex USA, Inc: www.merkrete.com.
d. Substitutions: See Section 016000 - Product Requirements.

2.4 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Standard Grout: ANSI A118.6 standard cement grout.
1. Applications: Use where indicated on drawings and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
3. Color: As indicated on drawings.
4. Products:
a. Basis of Design: LATICRETE International, Inc: www.laticrete.com.
b. Custom Building Products: www.custombuildingproducts.com.
c. Merkrete, by Parex USA, Inc: www.merkrete.com.
d. Substitutions: See Section 016000 - Product Requirements.

2.5 MAINTENANCE MATERIALS

A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

2.6 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch gap, minimum.
2. Fluid or Trowel Applied Type:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 20 mils, maximum.
c. Products:
1) LATICRETE International, Inc; LATICRETE FRACTURE BAN SC: www.laticrete.com.
2) Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com.

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PART 3 EXECUTION

3.1 EXAMINATION

A. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.

B. Verify wall surfaces are smooth and flat within tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Vacuum clean surfaces and damp clean.

B. Seal substrate surface cracks with filler.

C. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated on drawings. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated on drawings.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

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K. Grout tile joints unless otherwise indicated on drawings. Use standard grout unless otherwise indicated on drawings.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, on ground, with standard grout, unless otherwise indicated on drawings.

3.5 INSTALLATION - WALL TILE

A. Over gypsum wallboard on wood or metal studs, install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

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SECTION 093050 - TILE TRIM AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Edge-protection and transition profiles for floors.

B. Finishing and edge-protection profiles for walls.

1.2 RELATED REQUIREMENTS

A. Section 093000 - Tiling.

1.3 REFERENCE STANDARDS

A. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.

B. ANSI A118.13 - American National Standard Specification for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation.

C. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors.

D. IAPMO PS 106 - Tileable Shower Receptors and Shower Kits.

E. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on specified products, describing physical characteristics; including sizes, patterns and colors/finishes available; and installation instructions.

C. Selection Samples: Submit manufacturer's complete set of finish/color samples for Architect's initial selection.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches long, representing actual product, color, and finish.

E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

F. Manufacturer's Certificates: Certification tha products meet or exceed specified requirements.

G. Warranty document showing duration and scope to be submitted with product submittals.

1.5 QUALITY ASSURANCE

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A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

D. Source Limitations for Tile Trim and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.

E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship is are approved by Architect.
3. Reinstall mock-up area as required to produce acceptable work.

F. Preinstallation Conference: Conduct conference at the Project site in conjunction with preinstallation conference required in Section 093000 - Tiling.
1. Convene one week prior to commencing work of this section.
2. Require attendance of itile 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.

D. Protect tim materials from damage by storing on end.

1.7 PROJECT CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.8 WARRANTY

A. Provide sample warranty during submittal process.

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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 trim profile 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 and wall finish materials to avoid damage to installed materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Schluter Systems L.P.; www.schluter.com/schluter-us/en_US/.

B. Substitutions: See Section 016000 - Product Requirements.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

A. L-shaped profile with 1/8 inch 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: AE: Satin Anodized Aluminum.
   4. Product:
      a. Basis of Design: Schluter Systems L.P.; Schluter-SCHIENE; www.schluter.com/schluter-us/en_US/.

2.3 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

A. Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
   1. Corners and Connectors: Provide matching inside corners, outside corners, and internal connectors.
   2. Profile Height: As required to coordinate with tile selection and setting system.
   3. Material and Finish: AE: Satin Anodized Aluminum.
   4. Product:
      a. Basis of Design: Schluter Systems L.P.; Schluter-QUADEC; www.schluter.com/schluter-us/en_US/.

PART 3 EXECUTION

3.1 EXECUTION, COORDINATION

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A. Coordinate the work of this section with the work of Section 093000 - Tiling.

3.2 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.

3.3 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.

3.4 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Utilize longest length trim pieces manufactured. Only install joined trim pieces when the length required exceeds the maximum lenth that is manufactured.

C. Install internal connectors from the trim manufacturer to align joined trim pieces.

D. Install corner pieces from the trim manufacturer to properly align trim pieces at inside and outside corners.

E. Cut pieces to required length ustilizing a fine saw. Do not cut trim pieces using snips or or similar scissor-type tools.

F. Install trim with the thin-set mortar used for the tile installation. Using a notched trowel, apply thin-set mortar to the area where the profile is to be placed. If the trim is to be used as edging for an outside wall corner, finish tiling one wall first; then trowel thin-set mortar over the corner area of the second wall.

G. Trowel additional thin-set mortar over the perforated anchoring leg to ensure full coverage and support of the tile edges.

H. Press the profile into the mortar and align.

I. Solidly embed the tiles so that the tiled surface is flush with the top of the profile; the profile should not be higher than the tiled surface, but rather up to approx. 1/32" (1 mm) lower.

J. Set the tile to the integrated joint spacer, which ensures a uniform joint of 1/16" - 1/8" (1.5 - 3 mm). With stainless steel profiles, leave a space of approximately 1/16" - 1/8" (1.5 - 3 mm).

K. Fill joints completely with grout or setting material.

L. Work with materials and tools that will not scratch or damage sensitive surfaces. Setting materials must be removed/cleaned immediately.

3.5 PROTECTION

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A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 093050

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SECTION 095100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.2 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies.

1.3 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

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1.6 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
1. USG Corporation: www.usg.com/ceilings.
2. Substitutions: See Section 016000 - Product Requirements.

B. Suspension Systems:
1. USG Corporation; Donn DX 15/16" Acoustical Suspension System: www.usg.com/ceilings.

2.2 PERFORMANCE REQUIREMENTS

2.3 ACOUSTICAL UNITS

A. Acoustical Panels ACT-1: Painted mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type III.
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inch.
4. Light Reflectance: 0.83 percent, determined in accordance with ASTM E1264.
5. NRC: 0.55, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
7. Panel Edge: Square.
8. Color: White.
9. Suspension System: Exposed grid.
10. Products:
a. Basis of Design: USG Corporation; Radar Acoustical Panels #2110: www.usg.com/ceilings.
b. Substitutions: See Section 016000 - Product Requirements.

2.4 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings and splices as required.
1. Materials:

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a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dip galvanized steel grid and cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
2. Profile: Tee; 15/16 inch face width.
3. Finish: Baked enamel.
4. Color: White.
5. Products:
a. Basis of Design: USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System: www.usg.com/ceilings.
b. Substitutions: See Section 016000 - Product Requirements.

2.5 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.

E. Perimeter Moldings: Same metal and finish as grid.
1. Size: As required for installation conditions and specified Seismic Design Category.
2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
3. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

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B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Install in bed of acoustical sealant.
2. Use longest practical lengths.
3. Miter corners.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
1. Cut to fit irregular grid and perimeter edge trim.
2. Make field cut edges of same profile as factory edges.
3. Double cut and field paint exposed reveal edges.

F. Install hold-down clips on panels within 20 ft of an exterior door.

3.5 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 CLEANING

A. Clean surfaces.

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B. Replace damaged or abraded components.

END OF SECTION 095100

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SECTION 096500 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

B. Section 260526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

1.3 REFERENCE STANDARDS

A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.

B. ASTM F1700 - Standard Specification for Solid Vinyl Floor in Modular Format such as Tile(s) or Plank(s).

C. ASTM F1861 - Standard Specification for Resilient Wall Base.

D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Verification Samples: Submit two samples, minimum 2 by 2 inch2 in size illustrating color and pattern for each resilient flooring product specified.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing specified flooring with minimum three years experience.

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B. Wall base, stair treads, reducer strips, and all other accessories to be from one manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store all materials off of the floor in an acclimatized, weather-tight space.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Protect roll materials from damage by storing on end.

1.7 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 TILE FLOORING

A. Vinyl Composition Tile - Type VCT-1: Homogeneous, with color extending throughout thickness.
   1. Manufacturers:
      a. Basis of Design: Tarkett Company; VCT II: www.commercial.tarkett.com.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   3. Size: 12 by 12 inch.
   4. Thickness: 0.125 inch.
   5. Color: As indicated on drawings.

2.2 RESILIENT BASE

A. Resilient Base - Type WB-1: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
   1. Manufacturers:
      a. Basis of Design: Johnsonite, a Tarkett Company; "Baseworks": www.commercial.tarkett.com.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Height: 4 inches.
   3. Style: Cove base.
   4. Thickness: 0.125 inch.
   5. Finish: Matte.
   6. Length: Roll.
   7. Color: As indicated on drawings.

2.3 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

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B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips:
1. Manufacturer:
a. Basis of Design: Johnsonite, a Tarkett Company: www.commercial.tarkett.com.
b. Substitutions: See Section 016000 - Product Requirements.
2. Color: Same as base

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

3.3 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
1. Spread only enough adhesive to permit installation of materials before initial set.
2. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Refer to Section 260526 for grounding and bonding to building grounding system.

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3. Fit joints and butt seams tightly.
4. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
1. Resilient Strips: Attach to substrate using adhesive.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

G. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.5 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.6 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and wax in accordance with manufacturer's written instructions.

3.7 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096500

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SECTION 096813 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

B. Section 096500 - Resilient Flooring.

1.3 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

E. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.5 QUALITY ASSURANCE

PART 2 PRODUCTS

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2.1 MANUFACTURERS

A. Tile Carpeting:
   1. Mannington Commercial: www.manningtoncommercial.com#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

A. Tile Carpeting, Type CPT-1: Tufted, solution dyed.
   1. Product: The Hocus manufactured by Mannington.
   2. Tile Size: 18 by 36 inch, nominal.
   3. Thickness: .279 inch.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Pattern: Observer.
   6. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
   8. Gauge: 5/64 inch.
   9. Stitches: 10.5 per inch.
   10. Pile Weight: 19 oz/sq yd.
   11. Density Factor: 7434 kilotex.
   12. Primary Backing Material: Polypropylene.

2.3 ACCESSORIES

A. Edge Strips: Specified in Section 096500 - Resilient Flooring .

B. Adhesives:

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.2 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

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E. Lay carpet tile in ashlar pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

3.3 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION 096813

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SECTION 099113 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   7. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.

B. Section 099123 - Interior Painting.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. SSPC-SP 1 - Solvent Cleaning.

C. SSPC-SP 2 - Hand Tool Cleaning.

D. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning.

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1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon, unopened, of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

1.7 MOCK-UPS

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide door and frame assembly illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Approved mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

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A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com.
2. Benjamin Moore: www.benjaminmoore.com.
3. Pittsburgh Paints: www.pittsburghpaintsco.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 016000 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

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B. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
3. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3 PAINT SYSTEMS - EXTERIOR

A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.
1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Light Industrial Coating, Water Based.
a. Products:
1) Pittsburgh Paints Pitt-Tech Plus EP DTM Industrial Enamel, 90-1610 Series, Semi-Gloss. (MPI #163)
2) Sherwin-Williams Pro Industrial DTM Acrylic, Semi-Gloss. (MPI #163)
3) Substitutions: See Section 016000 - Product Requirements

B. Cement Fiber Panels, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer.
2. Semi-gloss: Two coats of latex enamel.

C. Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel.

D. Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
2. Semi-gloss: Two coats of alkyd enamel.

E. Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
2. Semi-gloss: Two coats of alkyd enamel.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali-Resistant Water-Based Primer; for cement fiber panels.
a. Products:
1) Pittsburgh Paints Series Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #3)
2) Sherwin-Williams Loxon Concrete and Masonry Primer Sealer, LX02W50. (MPI #3)
3) Substitutions: See Section 016000 - Product Requirements
2. Water Based Primer for Galvanized Metal; for miscellaneous galvanized metals.
a. Products:
1) Pittsburgh Paints Pitt-Tech Plus EP DTM Industrial Primer, 90-1912 Series. (MPI #134)
2) Sherwin-Williams DTM Primer/Finish (MPI #134)
3) Substitutions: See Section 016000 - Product Requirements

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3. Rust-Inhibitive Water Based Primer; for lintels and other miscellaneous ferrous metals.
   a. Products:
      1) Pittsburgh Paints Pitt-Tech Plus EP DTM Industrial Primer, 90-1908. (MPI #107)
      2) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer. (MPI #107)
      3) Substitutions: See Section 016000 - Product Requirements

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Fiber Cement Siding: 12 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

G. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

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2. Prepare surface according to SSPC-SP 2.

H. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

I. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Concrete masonry units in utility, mechanical, and electrical spaces.
   10. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.

B. Section 099113 - Exterior Painting.

C. Section 210553 - Identification for Fire Suppression Piping and Equipment: Painted identification.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

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A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials.

C. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals.

D. SSPC-SP 1 - Solvent Cleaning.

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
2. Cross-reference to specified paint system products to be used in project; include description of each system.
3. Manufacturer's installation instructions.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
3. Allow 30 days for approval process, after receipt of complete samples by Architect.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal, unopened, of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.7 MOCK-UP

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A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 8 feet long by 8 feet wide, illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com.
2. Benjamin Moore: www.benjaminmoore.com.
3. PPG Paints: www.ppgpaints.com.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 016000 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

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A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.
   1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
   2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.3 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, and concrete masonry units.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Interior Latex.
      a. Products:
         1) Banjamin Moore Ultra Spec 500 Flat.
         2) PPG Paints Speedhide Zero Interior Latex, 6-51 Series, Flat.
         3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
         4) Substitutions: See Section 016000 - Product Requirements
   3. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
      b. Eggshell: MPI gloss level 3; use this sheen at walls.
   4. Primer: As specified under "PRIMERS" below.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
   1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
   2. Two top coats and one coat primer.
   3. Top Coat(s): Interior Alkyd, Water Based.
      a. Products:
         1) Benjamin Moore Advance Waterborne Interior Alkyd Semi-Gloss 794.
         2) Pittsburgh Paints Speedhide Interior/Exterior WB Alkyd, 6-1510XI Series, Semi-Gloss.
         3) Sherwin-Williams ProMar 200 Waterbased Acrylic-Alkyd, Semi-Gloss.
         4) Substitutions: See Section 016000 - Product Requirements
   4. Top Coat Sheen:

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a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

5. Primer: As specified under "PRIMERS" below.

C. Medium Duty Vertical: Including concrete masonry units in restrooms.

1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex.
   a. Products:
      1) Benjamin Moore Corotech Pre-Catalyzed Waterborne Epoxy, Eggshell.
      2) PPG Paints Pitt-Glaze WB1 High-Performance Pre-Catalyzed Waterborne Epoxy, Eggshell.
      3) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior/Exterior Latex Block Filler.
   a. Products:
      1) Benjamin Moore Ultra Spec High Build Masonry Block Filler 571.
      2) Pittsburgh Paints Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI.
      3) Sherwin-Williams Pro Industrial Heavy Duty Block Filler.
2. Interior Latex Primer Sealer.
   a. Products:
      1) Benjamin Moore Ultra Spec Interior Latex Primer N534.
      2) PPG Paints Speedhide Zero Interior Latex Sealer, 6-4900XI.
      3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer.
      4) Substitutions: See Section 016000 - Product Requirements
3. Interior Rust-Inhibitive Water Based Primer.
   a. Products:
      1) Bejamin Moore Ultra Spec HP Acrylic Metal Primer HP04.
      2) Pittsburgh Paints Pitt-Tech Plus Interior/Exterior EP DTM Waterborne Acrylic Primer/Finish, 90-1908. (MPI #107)
      3) Sherwin-Williams Pro Industrial DTM Primer.
      4) Substitutions: See Section 016000 - Product Requirements
4. Interior Water Based Primer for Galvanized Metal.
   a. Products:
      1) Benjamin Moore Ultra Spec HP Acrylic Metal Primer HP04.
      2) PPG Paints Pitt-Tech Plus Interior/Exterior DTM Waterborne Acrylic Primer/Finish, 4020 PF Series.
      3) Sherwin-Williams DTM Primer/Finish.
      4) Substitutions: See Section 016000 - Product Requirements

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

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C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Concrete:
1. 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.

G. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

I. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

J. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.

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2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

K. Shop-Primed Steel: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

L. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

M. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
5. Apply each coat to uniform appearance in thicknesses specified by manufacturer. The number of coats and film thickness required is the same regardless of the application method.
6. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
7. Sand wood and metal surfaces lightly between coats to achieve required finish.
8. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
9. 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.
10. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
11. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
12. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
13. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

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C. 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.

D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

E. 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.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. 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.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

G. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
1. Finished metal surfaces not to be painted include:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze.
   f. Brass.
2. Prefinished items not to be painted include the following factory-finished components:
   a. Toilet partitions.
   b. Acoustic materials.
   c. Metal louvers.
   d. Finished mechanical and electrical equipment, unless indicated otherwise.
   e. Light fixtures, unless indicated otherwise.
   f. Switchgear.
   g. Burnished and rock-faced concrete masonry units.
   h. Prefinished wood doors.
   i. Prefinished wood casework.
3. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
   a. Foundation spaces.
   b. Furred areas.
   c. Utility tunnels.

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d. Pipe spaces.
e. Duct shafts.

4. Operating parts not to be painted include moving parts of operating equipment such as the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
   e. Sprinkler heads.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

B. 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

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from 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.

3.6 PROTECTION

A. Protect finishes until completion of project.

B. 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.

C. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099123

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SECTION 102113.17 - PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Phenolic toilet compartments.

B. Urinal screens.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Blocking and supports.

B. Section 102800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, 2 by 3 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Phenolic Toilet Compartments:
   1. Basis of Design: ASI Accurate Partitions; Maximum Privacy Phenolic: www.asi-accuratepartitions.com/#sle.
   2. Substitutions: Section 016000 - Product Requirements.

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2.2 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-to-ceiling.
   1. Color: Single color as selected.

B. Doors:
   1. Thickness: 3/4 inch.
   2. Width: 24 inch.
   3. Width for Handicapped Use: 36 inch, door swing as indicated on the plans.
   4. Height: 118 inch.
   5. "No Sight" configuration.

C. Panels:
   1. Thickness: 3/4 inch.
   2. Height: 120 inch.
   3. Depth: As indicated on drawings.

D. Pilasters:
   1. Thickness: 3/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.3 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
   2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Wall and Pilaster Brackets: Anodized aluminum, black color; continuous type.

C. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.

D. Hardware: Black anodized aluminum:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Door Latch: Slide type with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

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B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

B. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.17

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SECTION 102641 - BALLISTICS RESISTANT PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Laminated fiberglass ballistics-resistant panels.

1.2 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Metal framing to receive ballistics-resistant panels.

1.3 REFERENCE STANDARDS

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

B. UL 752 - Standard for Bullet-Resisting Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's current data sheets on each product to be used.

C. Shop Drawings: Details of installation of ballistics-resistant panels, including plan views, elevations, sections, and details of the proposed installation with attachment methods.

D. Certificates: Submit printed data to indicate compliance with following requirements.
   1. UL Listing verification and UL 752 Current Test Results as provided by Underwriters Laboratories.

E. Manufacturer's Instructions: Indicate preparation and installation.

F. Manufacturer's qualification statement.

G. Installer's qualification statement.

H. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Specimen Warranty: Manufacturer warranty.

1.6 QUALITY ASSURANCE

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A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 MOCK-UPS

A. See Section 014000 - Quality Requirements for additional requirements.

B. Construct mock-up, 8 ft long by 8 ft wide, illustrating surface preparation techniques and application workmanship.

C. Locate where directed.

D. Approved mock-ups may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name, manufacturer's identification, and required UL certification labels until ready for installation.

B. Handle material with care to prevent damage. Stack panels flat, store inside under cover off the ground in a dry location, and protect from other construction activities.

1.9 FIELD CONDITIONS

A. Install products under environmental conditions (temperature, humidity, and ventilation) recommended by manufacturer.

1.10 WARRANTY

A. Manufacturer Warranty: Provide ten year manufacturer warranty for materials and workmanship against defects commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Laminated Glass Fiber Ballistics-Resistant Panels:
1. Basis of Design: Total Security Solutions; TSS Total Armor Bullet Resistant Fiberglass: www.tssbulletproof.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

2.2 LAMINATED FIBER BALLISTICS-RESISTANT PANELS

A. General:
1. Laminated fiber ballistics-resistant panels to be non-ricochet type. When struck by a bullet or projectile, the panels to delaminate in such a way that absorbs the energy, stops the projectile, and prevents ricochet or spalling.

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2. Ballistics Resistance of Joints: Equal to that of the panel.

B. Performance Requirements:
1. Ballistics Resistance Rating: Listed and labeled as tested in accordance with UL 752 Level 7 (5.56 mm assault rifle) threat rating.
2. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when tested in accordance with ASTM E84.

C. Laminated Fiber Panels:
1. Material: Multiple layers of fiberglass woven roving bonded together with resin and compressed into flat rigid sheets.
2. Panel Size: Maximum size to limit number of seams.
3. Panel Thickness: Minimum thickness required for selected UL 752 threat level.
4. Panel Weight: Minimum weight required for selected UL 752 threat level.
5. Attachment Method: Mechanical fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that substrates have been properly prepared.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation of this work.

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 panels in accordance with manufacturer's instructions and shop drawings and in proper relationship with adjacent construction.
1. Maintain ballistics-resistive rating at panel junctures with concrete floor and roof slabs, bullet-resistive door and window frames, and required penetrations.

B. Reinforce panel joints with a minimum 4 inch wide back-up layer of ballistics-resistant material, centered on panel joints.

C. Secure panels using screws or bolts.

3.4 PROTECTION

A. Protect installed panels from subsequent construction operations.

B. Touch-up, repair or replace damaged panels before Date of Substantial Completion.

END OF SECTION 102641

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Feminine hygiene disposals.

B. Grab bars.

C. Framed mirrors.

D. Paper towel combination units.

E. Seat cover dispensers.

F. Soap dispensers.

G. Specialty accessories.

H. Toilet tissue dispensers.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Wood blocking.

B. Section 092116 - Gypsum Board Assemblies: Placement of wood blocking, steel sheet blocking, and backing plates in stud wall construction for attachment of accessories.

C. Section 102113.17 - Phenolic Toilet Compartments.

1.3 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

C. ASTM C1036 - Standard Specification for Flat Glass.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.5 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

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B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: American Specialties, Inc: www.americanspecialties.com/#sle.

B. Bradley Corporation: www.bradleycorp.com/#sle.

C. Bobrick Washroom Equipment, Inc: www.bobrick.com/#sle.

D. Substitutions: See Section 016000 - Product Requirements.

2.2 FEMININE HYGIENE VENDORS AND DISPOSALS

A. Sanitary Napkin Disposal Unit: Stainless steel, self-closing door, locking bottom panel with full-length heavy-duty stainless steel multi-staked piano hinge, removable receptacle.
   1. Cabinet and Door: Fully welded, 22 gauge, 0.03 inch thick sheet.
   2. Products:
      a. Model 0852 - Satin Stainless Steel Finish - Sanitary Napkin Disposal - Surface-mounted.
      b. Substitutions: Section 016000 - Product Requirements.

2.3 GRAB BARS

A. Grab Bars (TA-4, TA-5 & TA-6): Type 304 stainless steel.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 lbf, minimum.
      b. Clearance: 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Smooth.
      d. Length and Configuration: As indicated in product listing.
      e. Products:
         1) Model 3401-36 - 36 inch length - Exposed Flange, 1-1/4 inch OD, Smooth - Straight Grab Bar.
         2) Model 3401-42 - 42 inch length - Exposed Flange, 1-1/4 inch OD, Smooth - Straight Grab Bar.
         3) Model 3401-18 - 18 inch length - Exposed Flange, 1-1/4 inch OD, Smooth - Straight Grab Bar.
         4) Substitutions: Section 016000 - Product Requirements.

2.4 MIRRORS

A. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass, ASTM C1036.

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1. Channel Frame: One piece roll formed 20 gauge, 0.0375 inch, 1/2 inch by 1/2 inch Type 304 stainless steel channel that encases mirror and backing with tight mitered corners, and tamperproof hanging system; satin finish.
2. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
3. Products:
   a. Model 0620 Series - Stainless Steel Chan-Lok Frame - Plate Glass Mirror-Channel Frame.
      1) Size: 18 by 30 inch.
   b. Substitutions: Section 016000 - Product Requirements.

2.5 PAPER TOWEL COMBINATION UNITS

A. Combination Towel Dispenser/Waste Receptacle: Stainless steel; seamless wall flanges, continuous heavy-duty stainless steel multi-staked piano hinges, tumbler locks on upper and lower doors.
   1. Mounting: Surface.
   2. Products:
      a. Model 0467-2 - Semi-recessed - Traditional Collection - Paper Towel Dispenser and Waste Receptacle - Multi, C-Fold - 7 gal.
      b. Substitutions: Section 016000 - Product Requirements.

2.6 SOAP AND HAND SANITIZER DISPENSERS

A. Soap Dispenser: Liquid soap dispenser, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
   1. Mounting: Recessed.
   2. Products:
      a. Model 0347 - Satin Stainless Steel Finish - Soap Dispenser - Liquid, Vertical Valve - 40 oz - Surface-mounted.
      b. Substitutions: Section 016000 - Product Requirements.

2.7 SPECIALTY ACCESSORIES

A. Seat Cover Dispenser: Stainless steel, reloading by concealed opening at base, tumbler lock.
   1. Products:
      a. Model 0477-SM - Satin Stainless Steel Finish - Toilet Seat Cover Dispenser - Surface-mounted.
      b. Substitutions: Section 016000 - Product Requirements.

2.8 TOILET TISSUE DISPENSERS

A. Toilet Tissue Dispenser: Double roll, surface-mounted, for jumbo rolls.
   1. Products:
      a. Model 0039 - Toilet Tissue Dispenser - Low Profile, Jumbo Roll - Surface-mounted.
      b. Substitutions: Section 016000 - Product Requirements.

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2.9 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide 2 keys for each accessory to Owner; all accessories keyed the same.

C. Stainless Steel Sheet: ASTM A666/A666M, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamperproof; security type.

H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.10 FABRICATION

A. Traditional Collection:
1. Basic Construction Requirements:
a. Doors: Type 304, 22 gauge, 0.0312 inch stainless steel, double pan construction, with 1/4 inch thick structural fiberboard core.
b. Cabinets: Type 304, 22 gauge, 0.0312 inch stainless steel, formed perimeter trim with 1/4 inch return to wall four sides; joints welded, sight-exposed welds finished to match sheet finish.
c. Hinges: Heavy-duty stainless steel multi-staked piano hinge, 3/16 inch diameter barrel, full length of cabinet; hinge leaves spot-welded to door and cabinet body.
d. Locks: Tumbler locks, keyed alike other toilet accessory locks, with one key for each lock.
e. Cabinet and Door Finish: No.4 satin finish.

2.11 FINISHES

A. Stainless Steel: Satin finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

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A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Other Accessories: As indicated on drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

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SECTION 104300 - EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Automated external defibrillator (AED) cabinets.

B. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Emergency Aid Cabinets and Accessories:
1. Basis of Design: Cubix Safety; Semi-Recessed AED Wall Storage Cabinet without Alarm SR-Ln: www.cubixsafety.com.
2. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
3. Modern Metal Products, a division of Technico, Inc: www.modern-metal.com.
4. Substitutions: See Section 016000 - Product Requirements.

2.2 EMERGENCY AID CABINETS

A. Type: Automated external defibrillator (AED).

B. Cabinet Construction: Non-fire-rated.

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1. Formed Textured powder coating finish steel sheet; 0.031 inch thick base metal.

C. Cabinet Configuration: Semi-recessed type.
1. Exterior nominal dimensions of 17 inch wide by 16 inch high by 3-1/4 inch deep.
2. Trim: Flat square edge, with 1 inch wide face.

D. Door: 0.031 inch metal thickness, reinforced for flatness and rigidity with recessed handle. Hinge door for 180 degree opening with two butt hinges.

E. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.

G. Fabrication: Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: Powder coat, white color.

I. Finish of Door Pull or Handle: Stainless steel.

J. Finish of Cabinet Interior: White powder coat.

2.3 ACCESSORIES

A. Cabinet Door Signage: 'AED" decal, or vinyl self-adhering, prespaced red lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, at height indicated on drawings..

C. Secure rigidly in place.

D. Cabinet Lettering:
1. Location: Face of door framing.
2. Apply lettering on factory-finished cabinets at the factory.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

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B. Adjust cabinet doors to operate smoothly without binding.

C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes. Replace cabinets that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

3.4 CLOSEOUT ACTIVITIES

A. See Section 017700 - Closeout Procedures for closeout submittals.

END OF SECTION 104300

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SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 061001 - Rough Carpentry - Architecture: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Product Data: Provide extinguisher operational features and extinguisher ratings and classifications.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.5 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. Basis of Design: Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com.

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2. Larsen's Manufacturing Co: www.larsensmfg.com.
3. Potter-Roemer: www.potterroemer.com.

B. Fire Extinguisher Cabinets and Accessories:
1. Basis of Design: Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com.
2. Larsen's Manufacturing Co: www.larsensmfg.com.
3. Potter-Roemer: www.potterroemer.com.
4. Substitutions: See Section 016000 - Product Requirements.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
1. Class: A:B:C type.
2. Size: 10 pound.
3. Finish: Baked polyester powder coat, red color.
4. Temperature range: Minus 65 degrees F to 120 degrees F.

2.3 FIRE EXTINGUISHER CABINETS

A. Utilize at locations marked "FEC"

B. Cabinet Construction: Non-fire rated.
1. Formed powder-coated steel sheet; 0.036 inch thick base metal.

C. Cabinet Configuration: Semi-recessed type.
1. Exterior nominal dimensions of 13-7/8 inch wide by 27-3/8 inch high by 6 inch deep.
2. Projected Trim: Returned to wall surface, with 1-1/2 inch projection, and 1-1/4 inch wide face.
3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

D. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch and recessed handle. Hinge doors for 180 degree opening with continuous piano hinge.

E. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

G. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.

H. Finish of Door Pull or Handle: Stainless steel.

I. Finish of Cabinet Interior: White colored enamel.

2.4 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

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1. Utilize at locations marked "FE"

B. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, at height indicated on the drawings.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

3.3 MAINTENANCE

A. See Section 017700 - Closeout Procedures for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for the service and maintenance of fire extinguishers for one years from Date of Substantial Completion.

END OF SECTION 104400

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SECTION 123600 - COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

1.2 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework

1.3 REFERENCE STANDARDS

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

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.

D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material.

E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material.

F. PS 1 - Structural Plywood.

1.4 SUBMITTALS

A. See Section 013300 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

C. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Natural Stone Institute (NSI) Accredited Natural Stone Fabricator; www.naturalstoneinstitute.org/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

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1.7 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Solid Surfacing Countertops (SSM-1 & SSM-2): Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Basis of Design: Formica Corporation; Everform Solid Surfacing: www.formica.com.
         2) Dupont; Corian Solid Surfacing: www.corian.com.
         3) Wilsonart; Wilsonart Solid Surface: www.wilsonart.com.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      d. Color and Pattern: As indicated on drawings.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
   6. Skirts: As indicated on drawings.

2.2 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.3 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.

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a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
4. Miter outside corner joints between surfaces.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations. Do not proceed if services and outlets conflict with back or side splashes.

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. Securely attach countertop substrate to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Attach solid surface countertops to substrate using compatible adhesive.

C. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING

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A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 123600

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SECTION 21 0517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves
2. Grout
3. Silicone sealants

B. Related Sections:

1. Section 210518 “Escutcheons for Fire-Suppression Piping”
2. Section 210523 “General Duty Valves for Fire Protection Piping”
3. Section 210529 “Hangers and Supports for Fire Suppression Piping and Equipment”
4. Section 210553 “Identification for Fire-Suppression Piping and Equipment”
5. Section 211313 “Wet-Pipe Sprinkler Systems”

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

B. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

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C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation
b. GE Construction Sealants
c. Polymeric Systems, Inc.
d. Schnee-Morehead, Inc., an ITW Company
e. The Sherwin-Williams Company

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic and non-traffic use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. May National Associates, Inc., A subsidiary of Sika Corporation

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes in concrete.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

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3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe.
3. Seal annular space between sleeve and piping; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078400 "Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

A. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves.

2. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or PVC pipe sleeves.

END OF SECTION

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SECTION 21 0518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

B. Related Sections:

1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210523 “General Duty Valves for Fire Protection Piping”
3. Section 210529 “Hangers and Supports for Fire Suppression Piping and Equipment”
4. Section 210553 “Identification for Fire-Suppression Piping and Equipment”
5. Section 211313 “Wet-Pipe Sprinkler Systems”

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co., A Masco company
2. Dearborn Brass
3. Jones Stephens Corp.
4. Keeney Manufacturing Company
5. Mid-America Fittings, Inc.
6. ProFlo; a Ferguson Enterprises, Inc. brand

2.2 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

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B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls where exposed below ceilings or in areas with no ceiling, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

d. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with chrome-plated finish.

e. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

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SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Check valves.
3. Bronze OS&Y gate valves.
4. Iron OS&Y gate valves.
5. NRS gate valves.
6. Trim and drain valves.

B. Related Sections:

1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210518 “Escutcheons for Fire-Suppression Piping”
3. Section 210529 “Hangers and Supports for Fire Suppression Piping and Equipment”
4. Section 210553 “Identification for Fire-Suppression Piping and Equipment”
5. Section 211313 “Wet-Pipe Sprinkler Systems”

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Non-rising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

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A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooved ends, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.
   a. Level 1: HLOT - Valves.
      1) Level 3: HLUG - Ball Valves, System Control.
      2) Level 3: HLXS - Butterfly Valves.
      3) Level 3: HMER - Check Valves.
      4) Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
   a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:
   a. Indicator posts.
   b. Valves.
      1) Gate valves.
      2) Check valves.
         a) Single check valves.

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3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:
1. Handwheel: For other than quarter-turn trim and drain valves.
2. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Company
2. NIBCO INC.
3. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (ball type), Class Number 1112.
2. Minimum Pressure Rating: 300 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Weatherproof housing with worm gear or traveling nut.

10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded or grooved ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 CHECK VALVES

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A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Globe Fire Sprinkler Company
3. NIBCO INC.
4. Reliable Automatic Sprinkler Co., Inc.
5. Tyco Fire & Building Products LP.
6. Victaulic Company.
7. Viking Corporation.
8. Watts Water Technologies, Inc.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 250 psig.
3. Type: Single swing or spring assisted check, suitable for vertical or horizontal installation.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, welded-in nickel, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.4 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.
2. NIBCO INC.
3. United Brass Works, Inc.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.

8. Supervisory Switch: External.
9. End Connections: Threaded.

2.5 IRON OS&Y GATE VALVES

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A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Company
2. Kennedy Valve; a division of McWane, Inc.
3. Mueller Co.; Water Products Division.
4. NIBCO INC.
5. Victaulic Company.
6. Watts Water Technologies, Inc.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 250 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.

8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved.

2.6 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Company
2. Kennedy Valve; a division of McWane, Inc.
3. Mueller Co.; Water Products Division.
4. NIBCO INC.
5. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 250 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.

8. Supervisory Switch: External.
9. End Connections: Flanged or Grooved.

2.7 TRIM AND DRAIN VALVES

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A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fire Protection Products, Inc.
   b. Globe Fire Sprinkler Company
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. Potter Roemer.
   f. Tyco Fire & Building Products LP.
   g. Victaulic Company.
   h. Watts Water Technologies, Inc.

2. Description:

   a. Pressure Rating: 175 psig
   b. Body Design: Two piece.
   c. Body Material: Forged brass or bronze.
   d. Port size: Full.
   e. Seats: PTFE.
   f. Stem: Bronze or stainless steel.
   g. Ball: Chrome-plated brass.
   h. Actuator: Handlever.
   i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
   j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fire Protection Products, Inc.
   b. NIBCO INC.
   c. United Brass Works, Inc.

2. Description:

   a. Pressure Rating: 175 psig.
   b. Body Material: Brass or bronze.
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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a. NIBCO INC.
b. United Brass Works, Inc.

2. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine grooved ends for form and cleanliness. Ends shall be clean and free from indentations and projections in the area from valve end to (and including) the groove.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

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C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Butterfly valves are not acceptable for shut-off duty.

H. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Equipment supports.

B. Related Sections:

1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210518 “Escutcheons for Fire-Suppression Piping”
3. Section 210523 “General Duty Valves for Fire Protection Piping”
4. Section 210553 “Identification for Fire-Suppression Piping and Equipment”
5. Section 211313 “Wet-Pipe Sprinkler Systems”

C. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Metal framing systems.
2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer licensed in the State of Georgia, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pre-galvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or Stainless steel.
2. Outdoor Applications: Stainless steel.

2.4 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.5 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink, and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

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3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install lateral bracing with pipe hangers and supports to prevent swaying.

F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

G. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

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B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use carbon-steel pipe hangers, supports and attachments for general service applications.

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E. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated stationary pipes for sizes NPS 1/2 to NPS 30.
2. Steel Pipe Clamps (MSS Type 4): For suspension of non-insulated stationary pipes for sizes NPS 1/2 to NPS 24.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes for sizes NPS 1/2 to NPS 8.
4. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes for sizes NPS 3/8 to NPS 3.
5. U-Bolts (MSS Type 24): For support of heavy pipes for sizes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes for sizes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes for sizes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes for sizes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers for sizes NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers for sizes NPS 3/4 to NPS 24, if longer ends are required for riser clamps.

G. Hanger-Rod Attachments: Comply with NFPA requirements.

H. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

I. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

J. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

K. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

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END OF SECTION

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SECTION 21 0553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

B. Related Sections:

1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210518 “Escutcheons for Fire-Suppression Piping”
3. Section 210523 “General Duty Valves for Fire Protection Piping”
4. Section 210529 “Hangers and Supports for Fire Suppression Piping and Equipment”
5. Section 211313 “Wet-Pipe Sprinkler Systems”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

C. Valve Schedules: Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each piping system to include in maintenance manuals.

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PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch-thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Stainless Steel
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 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.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, with predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 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.

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G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

D. Pipe-Label Colors:

1. Background Color: Red.
2. Letter Color: White.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch-thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain or S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

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1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire-link chain.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of fire protection equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

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B. Training Systems Pipe Labels: All fire suppression training systems shall be identified with labels that state “For Training Only” Each pipe label shall include this language along all piping serving a training system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions like those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.
b. Dry-Standpipe Training System: 1-1/2 inches, round.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

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SECTION 21 1313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel Pipe and Fittings
2. Pipe Joining Materials
3. Specialty Valve
4. Sprinkler Specialty Pipe Fittings
5. Sprinklers.
6. Alarm devices.
7. Pressure gauges.

B. Related Sections:

1. Section 210517 “Sleeves and Sleeve Seals for Fire-Suppression Piping”
2. Section 210518 “Escutcheons for Fire-Suppression Piping”
3. Section 210523 “General Duty Valves for Fire Protection Piping”
4. Section 210529 “Hangers and Supports for Fire Suppression Piping and Equipment”
5. Section 210553 “Identification for Fire-Suppression Piping and Equipment”

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

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B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Georgia, using performance requirements and design criteria obtained.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications:

a. Building Service Areas: Ordinary Hazard, Group 1.
b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
c. General Storage Areas: Ordinary Hazard, Group 1.
d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
e. Office and Public Areas: Light Hazard.
f. Special Occupancy Hazard: As determined by NFPA 13 and authorities having jurisdiction.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Special Occupancy Hazard: As determined by NFPA 13 and authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:

a. Light Hazard: 225 sq. ft.
b. Ordinary Hazard: 130 sq. ft.
c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes

1.6 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

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C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Georgia responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural steel
2. Domestic water piping.
3. HVAC duct.
4. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Smoke Detectors
    d. Exit Signs

E. Qualification Data: For qualified Installer and professional engineer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval.

G. Welding certificates.

H. Grooved joint couplings and fittings shall be referred to on drawings and product submittals and be identified by the manufacturer’s listed model or series designation.

I. Fire hydrant flow test must be performed within 12 months of permit plan submission. Perform fire-hydrant flow test report, record and submit the following information:

1. Date
2. Time
3. Performed by
4. Location of Residual Fire Hydrant R
5. Location of Flow Fire Hydrant F
6. Static Pressure at Residual Fire Hydrant R (psig)
7. Measured Flow at Flow Fire Hydrant F (gpm)
8. Residual Pressure at Residual Fire Hydrant R (psig)

J. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

K. Field quality-control reports.

L. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

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1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in the State of Georgia.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 plain end.

C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. National Fittings, Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 536, ductile-iron casting; with dimensions matching steel pipe. Where short-pattern fittings are used in applicable sizes, they should have equal flow to standard pattern fittings.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber center-leg gasket with pipe stop for proper groove engagement, alignment and pipe insertion depth, and ASTM A449 compliant bolts and nuts.

    a. Flexible Type: For use in locations where vibration attenuation and stress relief are required.

2.3 PIPING JOINING MATERIALS

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A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch-thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Grooved Joint Lubricants: Lubricate gasket in accordance with the manufacturer's published instructions with lubricant approved for the gasket elastomer and fluid media.

2.4 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Globe Fire Sprinkler Corporation.

b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.

2. Description: Ductile iron body with rubber-faced clapper hinged to access cover. All moving parts capable of being serviced without removing valve from installed position. External bypass trim with non-interruptible pressure switch to activate remote alarm. Include taps for inlet and outlet pressure gauges, alarm devices and system main drain. Include all trim and alarm test valve.

3. Standard: UL 312 and FM Global's "Approval Guide"

C. Floor Control | Zone Assembly:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Globe Fire Sprinkler Corporation.

    b. Victaulic Company.

2. Description: Universal Manifold Check Valve: Where universal manifold check valves are specified for use in wet-pipe sprinkler systems, as floor control manifolds they shall be specifically listed for such use. Universal manifold check valves shall be ductile iron construction, incorporating a control valve, check valve, flow switch, test & drain assembly, adjustable relief valve, and system gauges in one compact body/footprint, and shall be manufactured for “right” and “left”-hand orientations. The test & drain assemble shall contain an adjustable relief valve, with a range of 175 to 310 psi, and a universal test orifice of K2.8; to provide testing capabilities of systems with k-factors ranging from K2.8 and larger. Universal manifold check valve shall be rated for use at the maximum service pressure of 300 psi and shall be UL listed and FM approved.

3. Standard: UL and FM Global’s “Approval Guide”

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

E. Air Venting Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AGF Manufacturing Inc. (Basis of Design Model 7910MAV)
    b. Globe Fire Sprinkler Corporation.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. Viking Corporation.

2. Standard: UL's "Product iQ". NFPA 13.
3. Pressure Rating: 300 psig minimum.
4. Body Material: Forge brass
5. Inlet/Outlet Size: 1/2-inch NPT.
6. End Connections: Threaded.

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2.5 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. National Fittings, Inc.
    c. Shurjoint Piping Products.
    d. Tyco Fire & Building Products LP.
    e. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CECA, LLC.
    b. Corcoran Piping System Co.
    c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

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1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.

    a. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. UL listed and FM approved rigid coupling to join sprinklers with IGS profile grooved ends to matching 1" IGS outlets; Coupling shall consist of two cast copper-alloy housing segments for connection of ½", ¾", and 1" sprinklers. Coupling shall include an EPDM Type A gasket, with zinc-plated cap screws conforming to ASTM F835, and nylon insert locknut. Rated for a working pressure to 175 psi.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating and as follows for specific situations (unless otherwise indicated or required by application):

D. Sprinkler Finishes:

1. Bronze.
2. Painted.

E. Corrosion resistant coatings to be one of the following unless indicated otherwise on plans:

1. Electroless Nickel PTFE Plated
2. Nickel/Teflon coating

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling or Sidewall Mounting: Plastic, white finish, one piece, flat to match sprinkler finish.
2. Outdoor or in areas exposed to moisture: Non-corrosive to match sprinkler head finish.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Globe Fire Sprinkler Corporation.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. Viking Corporation.

2. Standard: UL 199.

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3. Type: Wire cage with fastening device for attaching to sprinkler.

H. Flexible Sprinkler Drop Connections

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Material: Braided type 304 stainless steel flexible tube, zinc plated steel male threaded nipple or coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
3. Bend: Flexible tube shall have a UL approved minimum bend radius of 3 inches. The number of bends when installed shall not exceed allowable bends per manufacturer.
4. Union joints shall be provided for ease of installation.
5. The flexible drop shall attach to the ceiling grid using manufacturer approved bracket.
6. The bracket shall allow installation before the ceiling tile is in place.
7. The braided drop system shall be UL listed and FM Approved for sprinkler services to 175 psi.
8. Maximum length of flexible drop shall be 6 feet.
9. Flexible drop connection to branch shall only be permitted to be on the top half of the branch pipe.
10. Flexible sprinkler drops are only permitted with suspended ACT type ceiling and ceiling grid.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
   d. System Sensor

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.
6. Voltage: 24V

C. Water-Flow Indicators:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ADT Security Services, Inc.
    b. McDonnell & Miller; ITT Industries.
    c. Potter Electric Signal Company.
    d. System Sensor; a Honeywell company.
    e. Viking Corporation.
    f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFAC Inc.
    b. Potter Electric Signal Company.
    c. System Sensor; a Honeywell company.
    d. Tyco Fire & Building Products LP.
    e. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Fire-Lite Alarms, Inc.; a Honeywell company.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Potter Electric Signal Company.
    d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

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2.8 PRESSURE GAUGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Minimum Requirements:

1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
3. Pressure Gauge Range: 0 to 250 psig minimum.
4. Water System Piping Gauge: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

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E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install Inspector's Test Valve and drain directly after flow switch in sprinkler system riser piping. Connect inspectors test drain piping into system drain piping. Test valve to be located and installed according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install automatic (ball drip) drain valve in piping between fire-department connection and check valve. Install automatic drip at lowest point of piping practical to drain water from piping. Install drain piping from automatic ball drip to spill over nearest floor drain or to outside building. Piping out of building to be corrosion resistant with insect screen.

I. Install alarm devices in piping systems.

J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

K. Install pressure gauges on riser or feed main, at each sprinkler test connection. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they will not be subject to freezing.

L. Fill sprinkler system piping with water.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer's latest published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer's latest published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 210529 "Hangers and Supports for Fire Suppression Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.

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c. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

E. Install supports for vertical steel piping every 15 feet.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Check Valves: Include trim and drain-line connection with bypass check valve and retarding chamber.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install return bends in piping for all pendent type sprinkler heads.

C. Install sprinkler guards on sprinklers that are installed at or below 78 inches, or as indicated on plans.

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D. Dry-barrel type sprinkler heads shall be field measured to confirm final barrel length prior to ordering.

E. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.

F. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

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3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Drain Piping NPS 2 and smaller, shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3.13 SPRINKLER SCHEDULE

A. Provide quick response sprinkler heads for light and ordinary hazard areas and standard response sprinkler heads for extra hazard areas, unless prohibited by NFPA 13 or otherwise indicated.

B. Use sprinkler types with finishes indicated in subparagraphs below for the following applications unless indicated otherwise on plans:

1. Spaces with Ceilings: Semi-Recessed pendant sprinkler, white polyester finish with white escutcheon.
2. Wall Mounting: Semi-Recessed sidewall sprinkler, white polyester finish with white escutcheon.

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3. Below Overhead Doors: Sidewall sprinkler, rough bronze finish.
4. Finished Spaces without Ceilings: Upright sprinklers with white or chrome plated finish.
5. Unfinished Spaces without Ceilings: Upright sprinklers with rough bronze finish.
6. IT Room: Dry barrel horizontal sidewall sprinkler, white polyester finish with white escutcheon.
7. Special Applications: Extended-coverage, flow-control and ESFR sprinklers where indicated with finish to match other heads in space or in accordance with finishes above.
8. Corrosive Environments: Corrosion resistant finish shall be factory applied to all heads exposed to acids, chemical, moisture or other corrosive fumes.

C. Sprinklers for light and ordinary hazard classification areas shall be ordinary temperature heads with a red glass bulb and a minimum temperature rating of 155°F, unless indicated otherwise on drawings.

END OF SECTION

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SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Sections:
1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.

1.03 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air or nitrogen. Opening of sprinklers releases compressed air or nitrogen and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.05 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Georgia, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

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a. Unoccupied Attics: Ordinary Hazard, Group 1.
b. Office and Public Areas: Light Hazard.
c. Special Occupancy Hazard: As determined by NFPA 13, FM Global, and authorities having jurisdiction.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy, dry pipe system, with ceiling height up to 30':
      a) 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy, dry pipe system, with ceiling height up to 30':
      a) 0.20 gpm over 2500-sq. ft. area.
   c. Special Occupancy Hazard: As determined by NFPA 13, and authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft..
   b. Mechanical Equipment Rooms: 130 sq. ft.
   c. Electrical Equipment Rooms: 130 sq. ft.
   d. Combustible Attic Spaces: 130 sq.ft
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and **ASCE/SEI 7**.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in the State of Georgia responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. Compressed air piping.
   3. HVAC hydronic piping.
   4. Items penetrating finished ceiling including the following:

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a. Lighting fixtures.
b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

D. Fire hydrant flow test must be performed within 12 months of permit plan submission. Perform fire-hydrant flow test report, record and submit the following information:
1. Date
2. Time
3. Performed by
4. Location of Residual Fire Hydrant R
5. Location of Flow Fire Hydrant F
6. Static Pressure at Residual Fire Hydrant R (psig)
7. Measured Flow at Flow Fire Hydrant F (gpm)
8. Residual Pressure at Residual Fire Hydrant R (psig)

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.09 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer licensed in the State of Georgia.

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B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."

D. FM Global Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. FM Global Data Sheet 3-26, "Fire Protection for Nonstorage Occupancies."

1.11 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
   2. Do not proceed with interruption of sprinkler service without Owner's written permission.

1.12 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Grooved-Joint, Steel-Pipe Appurtenances:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Corcoran Piping System Co.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
   f. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
   1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. NIBCO INC.
      c. Victaulic Company.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.

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b. Crane Co.; Crane Valve Group; Crane Valves.
c. Fire Protection Products, Inc.
d. Globe Fire Sprinkler Corporation.
e. Milwaukee Valve Company.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.
h. Potter Roemer.
i. Reliable Automatic Sprinkler Co., Inc.
j. Tyco Fire & Building Products LP.
k. United Brass Works, Inc.
l. Victaulic Company.
m. Viking Corporation.
n. Watts Water Technologies, Inc.

2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

D. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

E. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Milwaukee Valve Company.
c. Mueller Co.; Water Products Division.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. United Brass Works, Inc.
g. Watts Water Technologies, Inc.
2. Standard: UL 262.

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3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. NRS Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. Mueller Co.; Water Products Division.
   c. NIBCO INC.
   d. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Non-rising.
6. End Connections: Flanged or grooved.

2.05 TRIM AND DRAIN VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International, Inc.
   b. Fire-End & Croker Corporation.
   c. Fire Protection Products, Inc.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Potter Roemer.
   g. Tyco Fire & Building Products LP.
   h. Victaulic Company.
   i. Watts Water Technologies, Inc.

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2. Port Size: Full

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

E. Plug Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Southern Manufacturing Group.

2.06 SPECIALTY VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Globe Fire Sprinkler Corporation.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.
2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) General Air Products, Inc.
2) Globe Fire Sprinkler Corporation.
3) Reliable Automatic Sprinkler Co., Inc.

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4) Tyco Fire & Building Products LP.
5) Victaulic Company.
6) Viking Corporation.

b. Standard: UL 260.
c. Type: Automatic device to maintain minimum air pressure in piping.
d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

6. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.
   b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.
   e. Mounting: Riser Mounted

C. Deluge Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AFAC Inc.
      b. BERMAD Control Valves.
      c. CLA-VAL Automatic Control Valves.
      d. Globe Fire Sprinkler Corporation.
      e. OCV Control Valves.
      f. Reliable Automatic Sprinkler Co., Inc.
      g. Tyco Fire & Building Products LP.
      h. Venus Fire Protection Ltd.
      i. Victaulic Company.
      j. Viking Corporation.
   2. Standard: UL 260.
   3. Design: Hydraulically operated, differential-pressure type.
   4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
   5. Dry, Pilot-Line Trim Set: Include dry, pneumatic actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Pneumatic actuator must receive a signal from fire detection system and

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a loss of air pressure on dry, pilot line side to allow actuator to open and water to flow into valve.

6. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) AFAC Inc.
      2) Globe Fire Sprinkler Corporation.
      3) Reliable Automatic Sprinkler Co., Inc.
      4) Tyco Fire & Building Products LP.
      5) Venus Fire Protection Ltd.
      6) Victaulic Company.
      7) Viking Corporation.
   b. Standard: UL 260.
   c. Type: Automatic device to maintain minimum air pressure in piping.
   d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
7. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.
   b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

D. Automatic (Ball Drip) Drain Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.07 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

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B. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Globe Fire Sprinkler Corporation.
      c. Reliable Automatic Sprinkler Co., Inc.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

D. Sprinkler Inspector's Test Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Globe Fire Sprinkler Corporation.
      c. Triple R Specialty.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
      f. Viking Corporation.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

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3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with integral sight glass.
5. Valve Type: Multi-position valve with positions for closed, test and drain.
   a. “Test Position shall be equivalent to a ½” sprinkler orifice discharge.
6. Size: 1 inch inlet and outlet.
7. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.08 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
1. Chrome plated.
2. Bronze.

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3. Painted.

E. Special Coatings to be one of the following unless indicated otherwise on plans:
   1. Electroless Nickel PTFE Plated
   2. Nickel/Teflon coating

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling or Sidewall Mounting: Plastic, white finish, one piece, flat to match sprinkler finish.
   2. Outdoor or in areas exposed to moisture: Non-corrosive to match sprinkler head finish.

G. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Globe Fire Sprinkler Corporation.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
      e. Viking Corporation.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.09 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fire-Lite Alarms; a Honeywell company.
      b. Notifier; a Honeywell company.
      c. Potter Electric Signal Company.
   2. Standard: UL 464.
   3. Type: Vibrating, metal alarm bell.
   4. Size: 8-inch minimum diameter.
   5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Pressure Switches:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Potter Electric Signal Company.
      b. System Sensor; a Honeywell company.
      c. Tyco Fire & Building Products LP.

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d. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.10 MANUAL CONTROL STATIONS

A. Standard: UL listed or FM Global approved.

B. Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

2.12 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK, Inc.; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.

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4. WIKA Instrument Corporation.

B. Minimum Requirements:
1. Standard: UL 393.
2. Dial Size: 3-1/2- to 4-1/2-inch diameter.
3. Pressure Gage Range: 0 to 250 psig minimum.
4. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
5. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 WATER-SUPPLY CONNECTIONS

A. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping**.**

3.03 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install Inspectors Test Valve and drain directly after flow switch in sprinkler system piping near riser. Connect inspectors test drain piping into system drain piping. Test valve to be located and installed according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

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I. Install automatic (ball drip) drain valve in piping between fire-department connection and check valve. Install automatic drip at lowest point of piping practical to drain water from piping. Install drain piping from automatic ball drip to spill over nearest floor drain or to outside building. Piping out of building to be corrosion resistant with insect screen.

J. Connect compressed-air supply to dry-pipe sprinkler piping.

K. Connect air compressor to the following piping and wiring:
   1. Pressure gages and controls.
   2. Electrical power system.
   3. Fire-alarm devices, including low-pressure alarm.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Drain dry-pipe sprinkler piping.

P. Pressurize and check dry-pipe sprinkler system piping, air-pressure maintenance devices and air compressors.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.04 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
      a. Install air compressor and compressed-air supply piping.
      b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.

3.06 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install return bends in piping for all pendent type sprinkler heads.

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C. Install sprinkler guards on sprinklers that are installed at or below 78 inches, or as indicated on plans.

D. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

E. Dry-barrel type sprinkler heads shall be field measured to confirm final barrel length prior to ordering.

3.07 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.09 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

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3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, dry-pipe sprinkler system, NPS 2½" and smaller, shall be the following:
   1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, dry-pipe sprinkler system, NPS 3 to NPS 6, shall be the following:
   1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. All sprinklers shall be quick response type unless prohibited by NFPA 13.

B. Use sprinkler types with finishes indicated in subparagraphs below for the following applications unless indicated otherwise on plans:
   1. Spaces with Ceilings: Dry-barrel type Semi-Recessed pendant sprinkler, white polyester finish with white escutcheon.
   2. Wall Mounting: Dry-barrel type semi-recessed sidewall sprinkler, white polyester finish with white escutcheon.
   3. Finished Spaces without Ceilings: Upright sprinklers with white or chrome plated finish.
   4. Unfinished Spaces without Ceilings: Upright sprinklers with rough bronze finish.
   5. Special Applications: Extended-coverage, flow-control and ESFR sprinklers where indicated with finish to match other heads in space or in accordance with finishes above.
   6. Corrosive Environments: Corrosion resistant finish shall be factory applied to all heads exposed to acids, chemical, moisture or other corrosive fumes.

END OF SECTION 211316

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

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G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Performance: The product shall meet the listed performance specifications.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
3. Aboveground Pressure Piping: Pipe fitting.

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B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180°F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

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D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

D. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

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D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at slopes indicated on the drawings. If not specified slope piping as required by the plumbing code.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required in floors for holes formed by removable sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

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2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 076200 Section "Sheet Metal Flashing and Trim" for flashing.

      1) Seal space outside of sleeve fittings with grout.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

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D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

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3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases not less than 4 inches larger in both directions than supported units.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078400 Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

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4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078400 "Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

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1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

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SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

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1. Escutcheons for New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type.

    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

    e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

    f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.

    g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

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SECTION 220519 - METERS AND GAGES

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 meters and gages for mechanical systems.

1.3 SUBMITTALS

A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.

B. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Performance: The product shall meet the listed performance specifications.

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:

1. Domestic Hot Water: 30 to 180ºF, with 2-degree scale divisions.

2. Domestic Cold Water: 0 to 100ºF, with 2-degree scale divisions.

B. Accuracy: Plus or minus 1% of range span or plus or minus one scale division to maximum of 1.5% of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

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A. Description: ASTM E 1.

B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9″ long.

C. Adjustable Joint: Finish to match case, 180º adjustment in vertical plane, 360º adjustment in horizontal plane, with locking device.

D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.

E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.

F. Stem: Aluminum or brass for separable socket; of length to suit installation.

2.4 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2″, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.5 THERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2″, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.6 TEST PLUGS

A. Description: Nickel-plated, brass-body test plug in NPS 1/2 fitting.

B. Body: Length as required to extend beyond insulation.

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C. Pressure Rating: 500 psig minimum.

D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8″OD probe from pressure gage.

E. Core Insert: Self-sealing valve, suitable for inserting 1/8″OD probe from pressure gage.

F. Core Material for Air and Water: Minus 30 to plus 275ºF, ethylene-propylene-diene terpolymer rubber.

G. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

PART 3 - EXECUTION

3.1 METER AND GAGE INSTALLATION, GENERAL

A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

A. Install thermometers and adjust vertical and tilted positions.

B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

1. Install with socket extending to center of pipe.

2. Fill sockets with oil or graphite and secure caps.

C. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.

1. Install with stem extending to center of pipe.
2. Fill wells with oil or graphite and secure caps.

D. Install thermometers in the following locations:

1. Outlet of water heater.
2. Where indicated on the drawings or specified elsewhere.

3.3 CONNECTIONS

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A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

3.4 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

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C. NSF Compliance: Comply with NSF 61 and NSF 372 for products serving domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, soldered ends and flange faces.
3. Set ball valve open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

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2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.; Apollo Valves.
    b. Milwaukee Valve Company.
    c. NIBCO INC.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-110.
    b. SWP Rating: 150 psig.
    c. CWP Rating: 600 psig.
    d. Body Design: Two piece.
    e. Body Material: Bronze.
    f. Ends: Threaded.
    g. Seats: PTFE or TFE.
    h. Stem: Stainless steel.
    i. Ball: Stainless steel, vented.
    j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Red-White Valve Corporation.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or gate valves.
2. Pump-Discharge Check Valves:

    a. NPS 3 and Smaller: Bronze swing check valves with bronze disc.

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B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC WATER SERVICE VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

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1.6 QUALITY ASSURANCE

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. Flex-Strut Inc.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut Corporation; Tyco International, Ltd.
g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.

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4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Vinyl or Epoxy or Alkyd.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

C. Coordinate building attachments with building construction.

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2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

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B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

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2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

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4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

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3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports or metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

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12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

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3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.

1.3 ACTION SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 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

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for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 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.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

2. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

END OF SECTION 220553

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Insulation Materials.
2. Insulating Cements
3. Adhesives
4. Mastics
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail application of field-applied jackets.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

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1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000-Degree Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Insulated, Division of MFS, Inc; Triple I.
   b. P.K. Insulation Mfg. Co, Inc; Super-size.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Insulated, Division of MFS, Inc; Smooth-cote.

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b. P.K. Insulation Mfg. Co, Inc; PK No. 127. Quick-cote
c. Rock wool Manufacturing Company; Delta one shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   b. Eagle Bridges - Marathon Industries; 501.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
   d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
   c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

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2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following.
    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
    a. ITW Insulation Systems; Gerrard Strapping and Seals.
    b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. C & F Wire.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    b. McGuire Manufacturing.
    c. Plumberex.
    d. Truebro; a brand of IPS Corporation.
    e. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

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2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

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J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Testing agency labels and stamps.
2. Nameplates and data plates.
3. Cleanouts.

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3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation.
3. Insulate tee fittings with preformed fitting insulation.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. Install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

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3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

E. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.6 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All pipe sizes: Insulation shall be the following:

a. Mineral Fiber: 1 inch thick with ASJ.

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B. Domestic Hot Water and Recirculated Hot Water:

1. All pipe sizes: Insulation shall be the following:

a. Mineral Fiber: 1 inch thick with ASJ.

C. Storm Sewer Piping and Roof Drain Body

1. Mineral Fiber: 1 inch thick with ASJ.
2. Mineral Fiber Blanket for roof drain body.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Protective Shielding Pipe Covers

3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Piping:

1. None.

B. Pipe fittings:

1. Preformed PVC fitting covers: 20 mils thick.

END OF SECTION 220719

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

B. Related Requirements:

1. Section 331000 "Water Utilities" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

1.4 Product Data: ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Provide piping schedule indicating type of intended installation and installation location. Refer to piping schedule below.

1.5 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.6 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions:

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1. Notify Owner no fewer than three working days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61 and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mueller Industries.
    b. Cambridge-Lee Industries.
    c. Cerro Flow Products

B. Soft Copper Tubing, Annealed Temper: ASTM B 88, Type K.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mueller Industries.
    b. Cambridge-Lee Industries.
    c. Cerro Flow Products

C. Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. NIBCO.
    b. Elkhart Products Corporation
    c. Cello Products.

2. MSS SP-123.
3. Cast-copper-alloy, hexagonal-stock body.
4. Ball-and-socket, metal-to-metal seating surfaces.
5. Solder-joint or threaded ends.
6. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
7. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

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8. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black.

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2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Matco-Norca.
b. McDonald, A. Y. Mfg. Co.
c. Watts; a division of Watts Water Technologies, Inc.
d. Wilkins; a Zurn company.

2. Standard: ASSE 1079.

3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.

4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" site work for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction

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loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground ductile-iron pipe in PE encasement according to ASTM A674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install thermometers on inlet and outlet piping from each water heater.

R. Install escutcheons for piping penetrations of walls, and ceilings.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 3 and NPS 4: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

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3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least two days before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

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2. Piping Tests:

    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

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1) Fill system or part thereof with water/chlorine solution with at least 50 ppm chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to third party testing lab. Then provide report to authorities having jurisdiction for approval.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, piping, NPS 4 and smaller, be the following:

1. Mechanical-joint, ductile-iron pipe; standard pattern, mechanical-joint fittings; and mechanical joints.

D. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Water mixing valves.
6. Water-hammer arresters.
7. Trap Seal Protection Device

B. Related Requirements:

1. Section 221116 "Domestic Water Piping".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

C. Provide valve and hydronic specialties schedule indicating type of intended installation and installation location. Refer to schedule below.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. Prier Products, Inc.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
   e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: As shown on drawings
6. Body: Bronze
7. End Connections: Threaded and Flanged.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:

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a. Valves: Ball type with threaded ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE REDUCING VALVES

A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Conbraco Industries, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Design Inlet Pressure: 140 psig.
5. Design Outlet Pressure Setting: 65 psig

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Leonard Valve Company.
b. Powers; a division of Watts Water Technologies, Inc.
c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.

9. Tempered-Water Design Flow Rate: 0.5-2.0 gpm.

2.7 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.
b. Precision Plumbing Products, Inc.
c. Watts Drainage Products.

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d. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.8 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ProVent Plumbing Systems Inc.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Sure Seal Manufacturing

2. Standard: ASSE 1072-2007.
3. Body: ASB Plastic
4. Diaphragm & Sealing Gasket: Neoprene Rubber
5. Size: Based on floor drain size.
6. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Do not install bypass piping around backflow preventers.

B. Install water pressure regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install Y-pattern strainers for water on supply side of each pump and where shown on drawings.

E. Provide water-hammer arresters in water piping according to PDI-WH 201.

F. Install water hammer arrestors on water piping at flush valve fixtures, pre-rinse spray faucets, washing machines and any quick closing valves.

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3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Reduced-pressure-principle backflow preventers.
2. Water pressure-reducing valves.
3. Non-potable Water Hose stations.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each backflow preventer and pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 PVDF Drainage Pipe and Fittings: ASTM F 1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with fusion- and/or mechanical-joint ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
b. Watts Industries (Canada) Inc.

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c. Zurn Plumbing Products Group; Chemical Drainage Systems.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

3. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.

2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

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3. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.

3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and

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reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.

L. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

M. Install underground PVC piping according to ASTM D 2321.

N. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

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B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

C. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits or nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

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E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

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E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

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3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following (Plenum return):

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

B. Aboveground, vent piping NPS 4 and smaller shall be any of the following (Plenum return):

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

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B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Josam Company.
2) MIFAB, Inc.
3) Smith, Jay R. Mfg. Co.
4) Tyler Pipe.
5) Watts Drainage Products.
6) Zurn Plumbing Products Group.

2. Refer to schedule on drawing.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products.

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h. Zurn Plumbing Products Group;

2. Refer to schedule on drawing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors or otherwise shown, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install floor-drain, trap-seal device on inlet to floor drains.

F. Install wood-blocking reinforcement for wall-mounting-type specialties.

G. Install traps on plumbing specialty drain outlets.

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3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

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SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

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PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Fernco Inc.
c. MIFAB, Inc.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.

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2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

4. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Dresser, Inc.
3) EBAA Iron, Inc.
4) Ford Meter Box Company, Inc. (The)
5) JCM Industries, Inc.
6) Romac Industries, Inc.
7) Smith-Blair, Inc.; a Sensus company.
8) Viking Johnson; c/o Mueller Co.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Ductile iron.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

2.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

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H. Install piping to allow application of insulation.

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

M. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

2.6 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

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2.7 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:

    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits or nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

2.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.

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3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

2.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

2.10 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

2.11 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-

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foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

2.12 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

2.13 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground storm drainage piping NPS 6 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, storm drainage piping NPS 8 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221413

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SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Flashing materials.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mea-Josam Company.
b. Josam
c. Watts Water Technologies, Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.
e. MIFAB

2. Refer to schedule on drawing.

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2.2 CLEANOUTS

A. Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mea-Josam Company.
    b. MIFAB
    c. Josam
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Refer to schedule on drawing.

B. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mea-Josam Company.
    b. MIFAB, Inc.
    c. Josam
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mea-Josam Company.
    b. MIFAB, Inc.
    c. Josam
    d. Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: As required to match connected piping.

5. Closure: Countersunk or raised-head, drilled-and-threaded, brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.

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8. Wall Access: Round wall-installation frame and cover.

2.3 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

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G. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

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. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

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1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: Three years.
2) Controls and Other Components: Three years.

b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following but are not limited to, the following]:

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a. American Water Heaters.
b. Bradford White Corporation.
c. Lochinvar Corporation.
d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
e. State Industries.

2. Standard: UL 1453.
3. Storage-Tank Construction: ASME-code, steel vertical arrangement.

a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.

b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
c. Insulation: Comply with ASHRAE/IESNA 90.1.
d. Jacket: Steel with enameled finish.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

B. Capacity and Characteristics:

1. Refer to schedule on drawing.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following but are not limited to, the following:

a. American Water Heaters.
b. Bradford White Corporation.
c. Lochinvar Corporation.

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d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
e. State Industries.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

a. Refer to schedule on drawing.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

E. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

G. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

H. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

I. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

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C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

E. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

F. Fill electric, domestic-water heaters with water.

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G. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements.

C. Prepare test and inspection reports.

END OF SECTION 223300

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SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories, showers, and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Service sinks.
10. Pressure Water Coolers with Bottle Filling Station

B. Related Sections include the following:

1. Division 22 Section 221119 "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

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G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

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1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
4. Stainless-Steel Residential Sinks: ASME A112.19.3.
5. Vitreous-China Fixtures: ASME A112.19.2M.
6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
7. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Shower Receptors: ANSI Z124.2.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

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PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard
b. Sloan Valve Company.
c. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Refer to schedule on drawing.

2.2 SERVICE SINK FAUCETS

A. Sink Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Chicago Faucets.
c. Speakman Company.
d. T & S Brass and Bronze Works, Inc.

2. See schedule on drawing.

2.3 FLUSHOMETERS

A. Flushometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard
b. Sloan Valve Company.
c. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Hard wired Powered Sensor Operated Flushometer for urinal and water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. See schedule on drawing.

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2.4 TOILET SEATS

A. Toilet Seats:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. American Standard Companies, Inc.
    b. Bemis Manufacturing Company.
    c. Church Seats.
    d. Eljer.
    e. Kohler Co.
    f. Olsonite Corp.

4. Description: Toilet seat for water-closet-type fixture.

    a. Material: Molded, solid plastic.
    b. Configuration: Open front without cover.
    c. Size: Elongated.
    d. Hinge Type: CK, check.
    e. Class: Standard commercial.
    f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Engineered Brass Co.
    b. McGuire Manufacturing Co., Inc.
    c. Plumberex Specialty Products Inc.
    d. TRUEBRO, Inc.
    e. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

3. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

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2.6 FIXTURE SUPPORTS

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. MIFAB Manufacturing Inc.
2. Smith, Jay R. Mfg. Co.
3. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
4. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Water-Closet Supports:

1. Description: Combination carrier designed for [accessible] [standard] mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.7 WATER CLOSETS

A. Water Closets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.
   d. Sloan Valve Company.

2. See schedule on drawing.

2.8 URINALS

A. Urinals:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

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a. American Standard Companies, Inc.
b. Eljer.
c. Kohler Co.
d. Sloan Valve Company.

2. See schedule on drawing.

2.9 LAVATORIES

A. Lavatories:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Eljer.
c. Kohler Co.

2. See schedule on drawing.

2.10 SERVICE BASINS

A. Service Basins:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Crane Plumbing, L.L.C./Fiat Products.
b. Fiat
c. Florestone Products Co., Inc.
d. Stern-Williams Co., Inc.
e. Mustee, E. L. & Sons, Inc.

2. See schedule on drawing.

2.11 PRESSURE WATER COOLER WITH BOTTLE FILLING STATION

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Elkay Manufacturing Co.
b. Halsey Taylor.
c. Oasis

2. Refer to schedule on drawing.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install counter-mounting fixtures in and attached to casework.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install toilet seats on water closets.

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L. Install shower flow-control fittings with specified maximum flow rates in shower arms.

M. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

N. Install chrome plated escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

O. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

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B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

1. Baldor (Basis of design)

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

D. Motors to have three (3) year parts warranty.

E. Efficiency rating shall appear on nameplate and shall be not less than as follows:

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F.

MINIMUM NOMINAL FULL LOAD EFFICIENCY FOR 60 HZ NEMA GENERAL PURPOSE ELECTRIC MOTORS (SUBTYPE I) RATED 600 VOLTS OR LESS (RANDOM WOUND)						
	OPEN DRIP-PROOF MOTORS			TOTALLY ENCLOSED FAN-COOLED MOTORS		
HP	2 POLES 3600 RPM	4 POLES 1800 RPM	6 POLES 1200 RPM	2 POLES 3600 RPM	4 POLES 1800 RPM	6 POLES 1200 RPM
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	88.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0
125	94.1	95.4	95.0	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95.0	95.8	95.4	95.4	96.2	95.8
250	95.0	95.8	95.4	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.5	95.8	95.8	96.2	95.8
450	95.8	96.2	96.2	95.8	96.2	95.8
500	98.5	96.2	96.2	95.8	96.2	95.8

MINIMUM NOMINAL FULL-LOAD EFFICIENCIES GENERAL PURPOSES ELECTRIC MOTORS (SUBTYPE II) AND ALL DESIGN B MOTORS GREATER THAN 200 HP								
	OPEN DRIP-PROOF MOTORS				TOTALLY ENCLOSED FAN-COOLED MOTORS			
HP	2 POLE 3600 RPM	4 POLE 1800 RPM	6 POLE 1200 RPM	8 POLE 900 RPM	2 POLE 3600 RPM	4 POLE 1800 RPM	6 POLE 1200 RPM	8 POLE 900 RPM
1	NR	82.5	80.0	74.0	75.5	82.5	80.0	74.0
1.5	82.5	84.0	84.0	75.5	85.5	84..4	85.5	77.0

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2	84.0	84.0	85.8	85.5	84.0	84.0	86.5	82.5
3	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
5	85.5	87.5	87.5	87.5	87.5	87.5	87.5	84.0
7.5	87.5	88.5	88.5	88.5	88.5	89.5	89.5	85.5
10	88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5
15	89.5	91.0	90.2	89.5	90.2	91.0	90.2	88.5
20	90.2	91.0	91.0	90.2	90.2	91.0	90.2	89.5
25	91.0	91.7	91.7	92.0	91.0	92.4	91.7	89.5
30	91.0	92.4	92.4	91.0	91.0	92.4	91.7	91.0
40	91.7	93.0	93.0	91.0	91.7	93.0	93.0	91.0
50	92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
60	93.0	93.6	93.6	92.4	93.0	93.6	93.6	91.7
75	93.0	94.1	93.6	93.6	93.0	94.1	93.6	93.0
100	93.0	94.1	94.1	93.6	93.6	94.5	94.1	93.0
125	93.6	94.5	94.1	93.6	94.5	94.5	94.1	93.6
150	93.6	95.0	94.5	93.6	94.5	95.0	95.0	93.6
200	94.5	95.0	94.5	93.6	95.0	95.0	95.0	94.1
250	94.5	95.4	95.4	94.5	95.4	95.0	95.0	94.5
300	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
350	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
400	95.4	95.4	NR	NR	95.4	95.4	NR	NR
450	95.8	95.8	NR	NR	95.4	95.4	NR	NR
500	95.8	95.8	NR	NR	95.4	95.8	NR	NR

MINIMUM AVERAGE FULL LOAD EFFICIENCY POLYPHASE SMALL ELECTRIC MOTORS			
	OPEN MOTORS		
HP	2 POLES 3600 RPM	4 POLES 1800 RPM	6 POLES 1200 RPM
0.25	65.6	69.5	67.5
0.33	69.5	73.4	71.4
0.50	73.4	78.2	75.3
0.75	76.8	81.1	81.7
1	77.0	83.5	82.5
1.5	84.0	86.5	83.8
2	85.5	86.5	N/A
3	85.5	86.9	N/A

MINIMUM AVERAGE FULL LOAD EFFICIENCY FOR CAPACITOR-START CAPACITOR-RUN AND CAPACITOR-START INDUCTION-RUN SMALL ELECTRIC MOTORS	
	OPEN MOTORS

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HP	2 POLES 3600 RPM	4 POLES 1800 RPM	6 POLES 1200 RPM
0.25	66.6	68.5	62.2
0.33	70.5	72.4	66.6
0.50	72.4	76.2	76.2.
0.75	76.2	81.8	80.2
1	80.4	82.6	81.1
1.5	81.5	83.8	N/A
2	82.9	84.5	N/A
3	84.1	N/A	N/A

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Motor Application: Provide the following enclosure types unless noted:

Environment/Location	Motor Enclosure Type
General Purpose	Open drip-proof with cast iron frame, TEFC with cast iron frame, or encapsulated
Outdoors, below grade or high humidity	TEFC with cast iron frame
Hazardous	Explosion-proof
Packaged Refrigeration Compressors	Hermetic or semi-hermetic

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

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E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

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E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 SHAFT GROUNDING RINGS

A. Motors for use with Variable Speed Drives:

1. Shaft Grounding ring on NEMA Premium and inverter duty motors consisting of conductive microfibers and grounding path.

B. Shaft Grounding Kit for Field Installation:

1. Field applied shaft grounding ring for motors controlled by variable frequency drives designed to be installed by the contractor.

PART 3 - EXECUTION

3.1 MOTORS

A. Furnished by the equipment manufacturer and selected and installed for the intended use. Motors to be accessible for maintenance and, where applicable, belt adjustment.

3.2 SHAFT GROUNDING RINGS

A. Wire Shaft Grounding Kit on motors for use with variable frequency drives:

1. Ensure shaft grounding kit is installed on motor in accordance with manufacturer’s recommendations.
2. Shaft grounding ring (SGR) is bolted directly to the motor end bracket for installed with conductive epoxy to ensure ground connection from the SGR to the motor frame.

END OF SECTION 230513

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Duct labels.
4. Stencils.
5. Above Ceiling Location Indicators.

1.3 ACTION SUBMITTALS

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

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

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4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 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.
7. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: Tabulate equipment identification number for each item of equipment to be labeled on 8-1/2x11-inch bond paper. Equipment scheduled shall be included in the operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 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.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

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3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated

2.4 DUCT LABELS

A. Self-Adhesive Labels: Printed plastic with contact-type, permanent-adhesive backing.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch

D. Minimum Letter Size: 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.

E. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 ABOVE CEILING EQUIPMENT LOCATOR STICKERS

A. Provide ¾” diameter colored stickers on ceiling at equipment above ceilings as follows:

1. Fire, Smoke, and Fire/Smoke Dampers – RED
2. Air Terminal Devices – GREEN
3. Valves - ORANGE

B. For lay in ceilings locate stickers at nearest ceiling grid bar. Do not place sticker(s) on ceiling tile.

C. Provide typewritten chart of Above Ceiling Equipment location with 8-1/2x11 schematic of project area indicating location. Frame and place under clear glass. Hang in mechanical space or other location as designated by the Owner’s Representative and provide a hard copy to the Owner’ Representative.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

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3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Coordinate naming convention of all equipment with the Owner and naming convention within the temperature control system. Tags on the contract documents may not accurately tag the equipment.

3.3 DUCT LABEL INSTALLATION

A. Install self-adhesive labels on uninsulated or lined ducts and stencils on ducts with external insulation. At each identification location, provide a flow direction arrow.

B. Lettering:

Duct Function	**Identification**
Supply Air	SA
Return Air	RA
Exhaust Air	EA
Outside Air	OA

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Variable-air-volume systems.
b. Constant-air-volume systems

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

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1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity currently and for the duration of the project, certified by NEBB or AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and currently certified by NEBB or AABC.
2. TAB Technician: Employee of the TAB contractor and individual who is currently certified by NEBB or AABC as a TAB technician.
3. TAB contractor shall maintain NEBB or AABC certification for the duration of the project.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine automatic balancing valves. Remove balancing valve cartridge and flush clean prior to system balance and verification.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

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N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" in this Section.

1. Comply with requirements in ASHRAE 62.1-2007, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

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3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer. Provide sheaves and belts as required to achieve indicated airflows.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

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3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts. Provide sheaves and belts as required to achieve indicated airflows.

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3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts

B. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

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B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.

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d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Coil static-pressure differential in inches wg.
g. Outdoor airflow in cfm
h. Return airflow in cfm
i. Relief airflow in cfm
j. Outdoor-air damper position.
k. Return-air damper position.
l. Relief-air damper position.

4. Plate heat exchanger test report

a. Exhaust entering and leaving air temperature in deg F
b. Outside air and supply entering and leaving air temperature in deg F
c. Face and bypass damper position

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E. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Entering-air, wet- and dry-bulb temperatures in deg F.
f. Leaving-air, wet- and dry-bulb temperatures in deg F.
g. Water flow rate in gpm.
h. Water pressure differential in feet of head or psig.
i. Entering-water temperature in deg F.
j. Leaving-water temperature in deg F.
k. Refrigerant expansion valve and refrigerant types.
l. Refrigerant suction pressure in psig.
m. Refrigerant suction temperature in deg F.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.

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d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.

H. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

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I. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psi.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg f.

J. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.

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2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All Work shall comply with the requirements of the Georgia Energy Code 2015, ASHRAE 90.1-2022, manufacturer's requirements for installation and these specifications. In the event of conflicts between these documents, the more stringent requirements shall met.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed and exposed air duct

B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Detail application schedule of intended insulation type for each type of application.

C. Installation guide for each type of insulation specified. Highlight intended installation method.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

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1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General" and "Ductwork Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

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C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Fiberglass Blanket Insulation:

1. Insulation Blanket meeting ASTM C 553, Type II, ASTM C 1290, Type III, and ASTM C 1138.

2. 'K' Value of 0.27 at 75°F mean temperature. Maximum Service Temperature (Faced): 250°F.

3. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, II, III, IV, VIII or FSK conforming to ASTM C 1136 Type II, IV. Provide ASJ jacket for ductwork to be painted.

4. Installation: Maximum allowable compression is 25%.

5. Density: Minimum 1.0 PCF.

F. Fiberglass Board Insulation:

1. Insulation Board meeting ASTM C 612 Type IA, IB and II, ASTM C 795 and ASTM C 1138.

2. 'K' Value of 0.23 at 75°F mean temperature. Maximum Service Temperature: 450º F.

3. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or conforming to ASTM C 1136 Type II, IV. Provide ASJ jacket for ductwork to be painted.

4. Concealed Areas: Minimum 3 lb./ft.3.

5. Exposed Areas: 6 lb./ft.3 minimum density for duct less than 8 ft. - 0 in. above finished floor or where indicated in these specifications or on the drawings.

G. Flexible Mineral Wool Blanket:

1. Mineral Wool bonded comply with ASTM C 553, Types I, II, and III, and ASTM C 1290 and ASTM C 1138.

2. ‘K’ value of 0.27 Btu-in/h-ft^2-F at a 75 deg F mean temperature. Maximum service temperature (faced): 250 deg F.

3. Vapor retarder jacket: FSK conforming to ASTMC 1136 Type II. Provide ASJ for ductwork to be painted.

4. Installation: Maximum allowable compression is 25%.

5. Density: Minimum 1.0 PCF.

H. Rigid Mineral Wool Board:

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1. Mineral Wool complying with UL/ULC Classified per UL 723. Comply with ASTM C 612, type 1A, 1B, and ASTM C 1138.

2. 'K' value of 0.23 Btu-in/h-ft^2-F at a 75 deg F mean temperature. Maximum service temperature (faced): 450 deg F.

3. Vapor retarder jacket: ASJ conforming to ASTM C 1136 type I, II, III, IV, VIII, and FSK conforming to ASTM 1136 type II, IV. Provide ASJ for ductwork to be painted.

4. Concealed areas: Minimum 3 lb/ft^3.

5. Exposed areas: 6 lb/ft^3 minimum density for duct less than 8 ft above finished floor or where indicated in these specifications or on the drawings.

I. Acceptable Manufacturers:

1. Fiberglass and Mineral Wool: Knauf, John Manville, Owen-Corning, Certainteed.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Fiberglass Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.

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c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller

2. Insulation finish shall be the insulation manufacturers recommended finish.
3. Adhesive shall be the insulation manufacturers recommended contract adhesives.
4. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
5. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Composition- synthetic rubber base with synthetic resins and fillers added

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

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2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ

2. Width: 3 inches
3. Thickness: 6.5 mils
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape

2.7 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins:

a. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:

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b. Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins:

a. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
b. Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Insulation-Retaining Washers:

a. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
b. Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
c. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

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C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches O.C.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches O.C.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. Insulate the tube bends and all exposed surfaces of duct coils operating in excess of 10 deg F differential from the ambient conditions.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 INSTALLATION OF FIBERGLASS AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. Draw jacket tight and smooth.
b. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
c. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
d. On rectangular duct sides with dimensions 24 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 18 inches O.C.
e. On rectangular duct sides with dimensions larger than 24 inches, place pins 18 inches O.C. each way and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing. Provide

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pins and clip washers at 18" O.C. in the bottom of duct, minimum of 2 rows longitudinally.

f. On round ductwork at 24" diameter and greater provide pins and clip washers at 18" O.C. in both directions from the horizontal centerline of duct downward.
g. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
h. Do not over-compress insulation during installation.
i. Impale insulation over pins and attach speed washers.
j. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
k. At all ductwork with external flanges, provide an 8" (min) piece of insulation wrapped around the duct, centered on the flange and securely taped.
l. Sagging duct insulation will not be acceptable.
m. Vapor retarders should overlap a minimum of two inches at all seams and be sealed with appropriate pressure sensitive tape. When applying pressure sensitive tapes, the tape must be firmly rubbed with the proper sealing tool to make sure the closure is secured. Follow tape manufacturers recommendations.
n. For below ambient services, apply vapor-barrier mastic over staples.
o. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
p. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

2. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch O.C. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches

3. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
4. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
5. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
6. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches O.C.
7. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

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8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches O.C.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On all duct sides, space pins 12 inches O.C. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    b. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    c. Do not over compress insulation during installation.
    d. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
    e. Vapor retarders should overlap a minimum of two inches at all seams and be sealed with appropriate pressure sensitive tape. When applying pressure sensitive tapes, the tape must be firmly rubbed with the proper sealing tool to make sure the closure is secured. Follow tape manufacturers recommendations.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch O.C. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
6. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
7. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints
8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

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inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

9. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches O.C. Tape and seal all ends and joints.
10. Vapor retarders should overlap a minimum of two inches at all seams and be sealed with appropriate pressure sensitive tape. When applying pressure sensitive tapes, the tape must be firmly rubbed with the proper sealing tool to make sure the closure is secured. Follow tape manufacturers recommendations.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches O.C. and at end joints.

3.7 FINISHES

A. Exposed insulation shall have paintable jacket material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Exhaust ducts
8. Supply and return duct with an interior temperature difference to the exterior of the ductwork which does not exceed 15 deg F.

3.10 DUCTWORK INSULATION SCHEDULE

Service	**Insulation Material**	**Thickness**	**Remarks**
HVAC Supply	Within mechanical rooms or exposed at 8 feet or less above finished floor: Rigid fiberglass, [Mineral Wool] Concealed: Flexible fiberglass, [Mineral Wool]	1-1/2 in. 2 in.	Min. installed R value of 6 Min. installed R value of 6
Supply or Return ducts in cold attic spaces or other un-conditioned spaces	Flexible fiberglass, [Mineral Wool]	5 in	Min. installed R value of 12
Exhaust ducts in cold attic spaces or other unheated spaces	Flexible fiberglass, [Mineral Wool]	3 in	Min. installed R value of 8
Supply ducts, exposed within the conditioned space served and downstream of the reheat coil		Not Insulated	Does not include the associated supply ductwork within the Mechanical Room or supply duct to the conditioned space.
Interior ductwork indicated to be lined		Not Insulated	
Return-air ducts within heated building envelope		Not Insulated	
Neutral ventilation air supply (between 65°F		Not Insulated	

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Service	Insulation Material	Thickness	Remarks
and 80°F)			
Outside air ducts and plenums, connections and mixing boxes	Rigid fiberglass, [Mineral Wool]	3 in.	Min. installed R value of 12 Provide neat fit at intake plenum
Exhaust, relief or vent ducts and plenums	Exposed: Rigid fiberglass, [Mineral Wool] Concealed: Flexible fiberglass, [Mineral Wool]	1-1/2 in. 2 in.	Min. installed R value of 8 Insulate 15 ft. from exterior opening and plenums

END OF SECTION 230713

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SECTION 230800 - COMMISSIONING OF HVAC

1.1 GENERAL

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.3 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Mechanical sections
2. Electrical sections
3. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 DEFINITIONS

A. The commissioning agent; the commissioning agent shall be as designated by the owner, architect or engineer. The commissioning agent shall represent the owner in matters relative to the commissioning procedures as defined in this and other related section of the contract documents.

1. The contractor shall be as defined in the general conditions and in the contract documents.
2. The owner shall be as defined in the general conditions and in the contract documents.
3. The architect/designer shall be as defined in the general conditions and in the contract documents.

B. Commissioning terms

1. Design intent: The designer intention is as defined by the architect as to the purpose of the specific complete system or any of the system components.

2. Commissioning procedures; Documenting, calibrating, checking, inspecting, starting, testing, verifying and training required to assure the proper operations of the mechanical and electrical systems defined in the contract documents.

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a. Pre-commissioning: checklists, commissioning checklists, pre-start checklist, commissioning functional documentation, deviation reports, preliminary and final test reports completed by the contractor to assure the mechanical systems and electrical systems are completed in accordance with the contract documents, manufactures requirements and in compliance with the design intent.
b. Commissioning functional tests are test that are of more detail than the start up tests performed by the contractor and/or the manufacture at start up.
c. The commissioning procedure is a cooperative effort by the designer, installing contractor, manufacture and the commissioning agent to ensure that mechanical, electrical, and control equipment, systems and components meet the design intent and to document the systems operation and compliance to the design intent.
d. The commissioning process includes the contractors' functions of start up, testing, balancing, calibration and set up of controls, training by the contractor.
e. The commissioning procedure testing and monitoring may include specific testing, trending and logging of the systems and /or components.
f. The contractor representative is an authorized contractor representative that shall be assigned as a qualified skilled technician to assist in the commissioning procedures.

3. Skilled technicians:

a. Personnel with specific expert knowledge of the system, components and/or control of the mechanical or electrical elements of the commissioned systems.
b. The skilled technician shall be qualified and have all tools required for commissioning the elements of the systems.
c. The skilled technician shall demonstrate a willingness and attitude of cooperation. The technician may be removed from the process at the request of the designer. The contract must replace the technician in this event with a technician meeting the above requirements.

4. Seasonal commissioning:

a. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions.
b. Initial commissioning tests will be done as soon as contract work is completed, regardless of season.
c. Subsequent commissioning tests will be undertaken as soon as practical to verify performance during the two seasons (peak heating, peak cooling or part load) not covered in initial testing.
d. Individual mechanical and electrical systems specifications indicate which systems require seasonal testing.

C. Commissioning team

1. Each contractor will designate one person, responsible for representing that facet of the project, to be on the Commissioning team. This person shall be the same person that is the lead person for installing and/or supervising the work of the trade being represented.
2. The commissioning team shall consist of the Owner, Commissioning Agent, Construction Manager, Mechanical Contractor, Electrical Contractor, General Contractor, Mechanical Contractor and sub contractors, Electrical Contractor and sub contractors, Test and Balance Contractor, Temperature Controls Contractor and the Engineer.

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1.6 COMMISSIONING DUTIES

A. Duties of Engineer:

1. Submit copy of the Design Intent Data to Owner, and review with Owner for acceptability.
2. Incorporate Design Intent data into bid and contract documents for contractor pricing and performance.
3. Prepare Commissioning Procedures for each the system based on actual system configuration.
4. Incorporate Commissioning Procedures into bid and contract documents for contractor pricing and performance.
5. Develop an integrated commissioning schedule with input from the contractor and representatives of all the installers.
6. Not authorize commissioning tests until each system is complete, including start-up procedures.
7. Coordinate communications related to commissioning by receiving and distributing submittal reviews, deficiency notices, and test results.
8. Identify problems; notify responsible parties, and direct actions required to correct deficiencies in EEM equipment and systems.
9. Remove Energy Efficiency Measures disputes by performing research to determine the scope of the dispute, and informing the involved parties on the possible solutions to the dispute.
10. Notify the Contractor if Contractor-initiated system changes have been made that alter the commissioning process.
11. Determine the acceptance procedures for each item of the equipment and system. The criteria for acceptance of the equipment and systems will closely follow the test outline in each Section specifying the equipment.
12. Submit the final commissioning report including al submittals and test results for each to the Utility and Owner. Commissioning Report shall be included in Part 5 of each section of the Closeout Manual.
13. Recommend final acceptance of contractor's work to the Owner when commissioning tests have been successfully completed.

B. Duties of Contractor:

1. Provide Commissioning Agent with access to the building and the work.
2. Provide input (in coordination with the installers) to the designer to develop an integrated commissioning schedule.

3. Coordinate work with commissioning work.
4. Ensure commissioning tasks and deliveries are performed in accordance with the Commissioning Schedule and Contract Documents.
5. Provide training to the Owner relative to the equipment components and the overall operation of the entire systems

C. Duties of Equipment and Systems Installers:

1. Review and approve Commissioning Procedures.

   a. Review is confined to ensuring test procedures are executable, will not damage equipment or systems, and will not affect warranties.

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b. Review pre-commissioning checklists and functional performance test plans and data sheets for capability of verifying that the equipment and systems meet the Design Intent.
c. Provide assistance in functional performance testing and test and balancing, i.e. the TC contractor shall open all the vav boxes to test the unit at 100% speed so that the air flow measuring stations can be accurately calibrated.
d. Consult with equipment and systems manufacturers as required to verify that tests will not damage equipment and systems.
e. If installer deems it necessary for protecting equipment, they shall forward these documents to the appropriate manufacturer's representatives for review and editing.

2. Provide Skilled Technicians for execution of commissioning procedures including seasonal testing required after initial commissioning when required by Contract Documents.
3. Participate in resolution of disputes related to commissioning.
4. Provide qualified personnel for correction of deficiencies.
5. Train Owner's maintenance personnel in operation and maintenance of equipment and systems.
6. Submit operation and maintenance and as-built drawings for equipment and systems to Designer.
7. Installers shall cooperate with other Installers on commissioning Work that requires participation of multiple Installers.
8. Provide input (in coordination with the Contractor and other installers) to the Architect to develop an integrated commissioning schedule.
9. Commissioning does not relieve Installers from participating in the review process not diminish the Installer's role and obligations to complete other Work as required by Contacts Documents.

D. Duties of Commissioning Agent

1. Engage Commissioning Team

a. The Commissioning Team assists in planning, reviewing and coordination of commissioning activities with all disciplines involved in the building project. The Commissioning Team shall include the following members at a minimum. Contractors will not join the team until they are selected through the normal procurement process.

i) Commissioning Leader
ii) Facility Operations Manager (FOM)
iii) Project Manager
iv) Designers
v) Contractors
vi) Energy Modeler (if energy modeling is part of the project)
vii) Guideline Leader

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2. The Commissioning Leader facilitates and coordinates the efforts of the commissioning team. For Design and Construction Commissioning, the commissioning leader shall have a distinct role from the design team but may be employed within a firm providing design services. The Facility Operations Manager is accountable for facility performance during ongoing occupancy and will manage or perform ongoing operations and maintenance following construction. This person is available to participate throughout the design and construction process for continuity into final operation.
3. Coordination of Owner's Project Requirements (as required by guideline P.1A) The Owner's Project Requirements (OPR) shall quantify functional performance expectations and parameters for each system to be commissioned. The OPR provides the common understanding that focuses design, construction, and commissioning activities on the desired outcome. The OPR shall be written in objective and measurable terms. Quantify parameters such as space temperatures, humidity levels, lighting levels, sound levels, and ventilation rates when applied to the conditioned building spaces. The OPR shall be updated every time the owner accepts an alternate requirement or performance criteria – due to owner desires, schedule, or budget. This might occur through normal design evolution, value engineering, change orders, or other supplemental instructions during construction.
   The OPR shall include an updated SB 2030 Energy and Carbon Standard for the project related to Guidelines E.1 and renewable energy requirements under E.2 and updated as the program and the project are refined. During the Correction Period and On-Going Operations, the OPR helps the owner/operators understand the requirements of the owner. It also provides the benchmark for maintenance, repair, and replacement decisions
4. Coordination with Basis of Design (as required by guideline P.1C) The Basis of Design (BOD) is a narrative description of how the systems will be designed in order to achieve the Owner's Project Requirement acceptance criteria.
5. Commissioning Design Review
   At least once during each of the Design, Final Design, review the design progress against the goals of the Owners Project Requirements. Commissioning Design Review comments shall be documented in writing and responses prepared by the appropriate designers
6. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
7. Coordinate the commissioning work with the contractor and construction manager, to ensure that commissioning activities are being incorporated into the master schedule.
8. Plan and conduct commissioning meetings as needed and distribute minutes.
9. Performance Check: Commissioning Team shall review design as documented to verify that it meets the physical outcomes and operational performance defined at that phase. Performance areas include, but are not limited to:

   a. Owner's Project Requirements acceptance criteria for all required and additional pursued Guidelines.
   b. Requirements for specific operational scenarios of the building.

10. Measurability/Testability Check: Commissioning Team shall review design as documented to verify that it meets criteria for testing and verification of performance for Design and Construction Commissioning as well as Operations Commissioning monitoring during Ongoing Occupancy. Performance areas include, but are not limited to:

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a. Measurements and testing required during all phases of Design and Construction Commissioning.
b. Measurement, monitoring, and control of energy, water, indoor environmental quality during ongoing occupancy.

11. Coordinate with Operations Commissioning and Energy Efficient Operations Manual Cooperate with the Operations Commissioning Team by incorporating design features required to perform Operations Commissioning. Refer to and coordinate with the completion of Guideline P.2A: SB 2030 Energy Efficient Operations Manual process.
12. List of I/O Data Points

    a. Submit a list of input and output (I/O) data points or sequence of operations as part of outcome documentation before the completion of the Final Design Phase. These shall be submitted for all computer-based control systems, e.g., HVAC, lighting controls which have programmable control logic.

13. Provide Cx Criteria & Scope for Construction Documents

    a. Provide a commissioning specification section for Division 1 of the project manual. The commissioning specification shall define and elaborate on the contractor's responsibilities as defined in the Commissioning Plan. Incorporate the Commissioning Plan into the contract documents by reference in order to communicate the context of the commissioning specification and information regarding other team member responsibilities.

14. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
15. Coordinate and direct commissioning activities.
16. Review normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
17. Review requests for information and change orders for impact on commissioning and owner's objectives.
18. Review coordination drawings to ensure that trades are making a reasonable effort to coordinate.
19. Write and distribute construction checklists for commissioned equipment.
20. Develop an enhanced start-up and initial systems checkout plan with contractors for selected equipment.
21. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
22. Perform the following pre-functional tasks:

    a. Witness HVAC piping pressure test and flushing, enough to be confident that proper procedures were followed. Include testing documentation in the Commissioning Record.
    b. Witness any ductwork testing and cleaning enough to be confident that proper procedures were followed. Include documentation in the Commissioning Record.

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c. Document construction checklist completion by reviewing completed construction checklists and by selected site observation.
d. Document systems startup by reviewing start-up reports and by selected site observation.
e. Approve air and water systems balancing by spot testing and by reviewing completed reports and by selected site observation.

23. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This will include manual functional testing, energy management control system trending and may include stand-alone datalogger monitoring.
24. Coordinate, witness and document manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during construction check listing by the installing contractors and spot-checked by the commissioning provider during functional testing. Analyze functional performance trend logs and monitoring data to verify performance. a. Tests on respective HVAC equipment shall be executed, if possible, during both the heating and cooling season. However, some overwriting of control values to simulate conditions shall be allowed. Functional testing shall be done using conventional manual methods, control system trend logs, and read-outs or stand-alone dataloggers, to provide a high level of confidence in proper system function, as deemed appropriate by the commissioning provider and the Owner.
25. Prepare test plans for, assist with execution of, and document tests of commissioned equipment overseen by regulatory authorities and ensure that such tests meet the testing rigor desired by the Owner.
26. Maintain a master issues log and a separate record of functional testing. Report all issues as they occur directly to the Owner's Representative. Provide directly to the Owner's Representative written progress reports and test results with recommended actions.
27. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
28. Oversee and review the training of the Owner's operating personnel prior to construction completion and system acceptance by the owner.

    a. Oversee the videotaping of this training.
    b. Review the creation of a classroom "owner's manual" that is to be kept in the classroom.
    c. Review the preparation of the O&M manuals for commissioned equipment.

29. Compile a Commissioning Record, which shall include:

    a. A brief summary report that includes a list of participants and roles, brief building description, overview of commissioning and testing scope, and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning provider regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

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1) Equipment meeting the equipment specifications,
2) Equipment installation,
3) Functional performance and efficiency,
4) Equipment documentation, and
5) Operator training.

30. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented.
31. Also included in the Commissioning Record shall be the issues log, commissioning plan, progress reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.
32. Compile a Systems Manual that consists of the following and at least the parts listed under ASHRAE 202-2013 Part 14.2.3: Owner's Project Requirements (by owner); Design Narrative and Basis of Design (by designer); Performance Metrics, if completed during design; space and use descriptions, single line drawings and schematics for major systems (by designer); control drawings, sequences of control (by contractor); and a table of all setpoints and implications when changing them, schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown, instructions for energy savings operations and descriptions of the energy savings strategies in the facility, recommendations for recommissioning frequency by equipment type, energy tracking recommendations, and recommended standard trend logs with a brief description of what to look for in them (all by commissioning leader).
33. Deferred Verification
Some of the system functional performance test procedures will not be practical or meaningful to complete prior to the Correction Period. This may be due to construction phasing, climate or other constraints. Those test procedures shall be completed at the earliest appropriate time, and the results of the tests shall be reported to the Owner and Project team. It shall be expected that deficiencies identified as part of this deferred testing executed after the Correction Period will be resolved by the project team as if they had been identified prior to the end of the Correction Period.
34. Warranty Period

    a. Coordinate and supervise required opposite season or deferred testing and deficiency corrections and provide the final testing documentation for the Commissioning Record and O&M manuals.
    b. Return to the site at 10 months into the 12-month warranty period as scheduled by the Owner's Representative, and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have with operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports and documents and requests for services to remedy outstanding problems.

E. Duties of all parties

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1. Attend all commissioning scope meetings and commissioning team meetings. These will take place on an every other week schedule unless progress of the project dictates otherwise.

1.7 TEST EQUIPMENT

A. Test Equipment:

1. Contractor or installer shall furnish industry standard test equipment for performing tests.

B. Proprietary Test Equipment:

1. Contractor or Installer shall provide proprietary test equipment required by equipment manufacturer.
2. The contractor shall demonstrate test equipment use and assist in the commissioning process.
3. The contractor shall provide instrument calibration and maintain test equipment a recommended by manufacturer.

1.8 EXECUTION

1.9 TESTING PREPARATION - COMMISSIONING PROCEDURES AT THE SITE

A. Coordination of Tests:

1. The commissioning agent shall develop an integrated Commissioning Schedule with input from the Contractor and all installers.
2. Contractor shall coordinate schedules of all installer representatives, and enforce participation in commissioning tests according to the Commissioning Schedule.
3. An installer shall not test work by another installer.
4. When testing systems that include work by multiple installers, representatives of all effected installers must be present.
5. Installer shall complete commissioning checklists during equipment and system start-up.
6. Commissioning tests of systems may proceed prior to final completion of systems to expedite the testing progress if approved by Designer.
7. Do not initiate functional performance testing for equipment or systems in advance of their start-up and checkout by all affected Installers for that equipment or system.
8. Test and record Mechanical, Control, and Electrical systems through each mode of operation using Commissioning procedures.

B. Test Acceptance Criteria:

1. The criteria for acceptance of each test is only if that test results will be in accordance with and demonstrate the Design Intent.
2. Input will be sought when necessary from the Designer to determine if test results indicate compliance with the Design Intent.
3. The Designer will recommend acceptance or rejection of work based on the test results.

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C. Resolution of Deficiencies:

1. Designer will review performance tests and notify the Contractor indicating the nature of deficiencies and steps to be taken.
2. Installer shall adjust defective equipment and systems to meet performance requirements under varying loads.
3. Contractor shall set the date for completion of corrective activities. This date shall be within fifteen (15) working days of the date the deficiency report was generated.

    a. The correction of issues described in the deficiency report must be signed by the party responsible for correcting the deficiency, and returned to the Commissioning Agent within the 15 day period.

4. If the date for completion of corrective work passes without resolution of deficiencies, Owner reserves the right to obtain supplementary services and equipment to correct the problem as indicated in the General Conditions.
5. Commissioning procedures shall be aborted and considered failed, if any commissioning team member, for whom participation is scheduled, is not present for the test.

    a. This will not be considered a failure if the test is rescheduled 48 hours (minimum) in advance of the scheduled testing.

6. Installer shall perform additional commissioning procedures until the required system performance is obtained.

D. Re-checking and Re-testing Charges:

1. In the event of a second failure of a commissioning procedure for equipment and systems, the Contractor will be assessed charges by the Designer, and other commissioning review parties to do additional testing on the site for re-testing equipment and systems.
2. Charges will be based on each party's expenses, including normal hourly billing rates, time for re-testing, travel time, travel expenses, and per diem, if required.

1.10 O&M MANUAL

1. Ensure that Operation and Maintenance Manuals are accurate and complete. Forward this document to the Owner.

1.11 PRE-FUNCTIONAL START-UP

A. Start-up reports shall be completed by qualified installers responsible for installing the piece of equipment.
B. The Contractor shall be responsible for performing any additional manufacturers or local codes officials' start-up requirements at no additional cost to the Owner.
C. The Contractor is responsible for ensuring a factory-authorized service representative is present for star-up procedures where such representation is mandated to attend start-up.
D. The Contractor shall verify the equipment checklist is completed before operating the equipment.
E. The completed start-up checklists shall be returned to the Commissioning Agent.
F. The equipment requiring prefunctional testing include, but are not limited to, the following:

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1. Air Handling Units
2. Ventilation Fans
3. VFD's
4. Air Terminal Units
5. Ductwork Insulation
6. Temperature Control
7. Temperature/Humidity Sensors
8. Pressure Sensors and Controllers
9. Sequence of Operation
10. Airflow Stations
11. Damper Actuators
12. Lighting Control/Daylighting Systems

G. Functional Start-Up

1. The equipment requiring functional testing may include all components of the mechanical system and is at the discretion of the Owner and Commissioning Agent. The minimum required shall be all components of the following:

    a. HVAC systems

END OF SECTION 230800

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SECTION 230993 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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 control sequences for HVAC systems, subsystems, and equipment.

1.3 DEFINITIONS

1.4 AIR HANDLING EQUIPMENT SEQUENCES

A. Package Rooftop Units (RTU-1 thru RTU-3)

1. General:

a. Variable volume system with supply fan, packaged DX heating and cooling, and economizer cycle.
b. The DX heating and cooling system shall be capable of modulating capacity.
c. The RTUs shall be controlled during the occupied/unoccupied modes via the factory provided controller, through an owner directed time schedule.
d. All control set points noted in this sequence shall be user adjustable and shall be tuned during system start up and commissioning for proper system operation.

2. Unoccupied:

a. Throughout the unoccupied period, the economizer damper shall modulate position to 100% return air, 0% outside air.
b. Each RTU shall have a single dedicated space temperature sensor provided to determine unoccupied space temperature. When the dedicated RTU space temperature sensor is between the unoccupied heating and cooling set points, the supply fan, heating and cooling shall be disabled.
c. On call for cooling, the supply fan shall be enabled. The outside air damper shall open if economizing is enabled and remain closed if economizing is disabled, and the mechanical cooling shall be enabled. Once space temperature falls 2°F below the unoccupied cooling set point, the unit shall enter unoccupied shutdown.
d. On call for heating, the unit shall be enabled. The leaving air temperature set point shall be set to 55°F. The unit shall return to unoccupied shutdown when the space temperature rises 2°F above the unoccupied heating set point.

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e. Unoccupied Schedule: Monday – Friday 7:00 p.m. – 5:00 a.m. Saturday, Sunday and Holidays.
   1) Heating set point: 62°F
   2) Cooling set point: 82°F

3. Occupied (adj.):

   a. Occupied Schedule: Monday-Friday 7:00 a.m. – 6:00 p.m.
   b. Fan shall be on.
   c. Supply air temperature setpoint: 55°F

4. Start-up:

   a. When initiated by manual command through the factory provided controller, the supply fan shall be enabled. After proof of operation, the PID loops for the cooling, heating section, and economizer shall be enabled.

5. Shutdown:

   a. When initiated by manual command through the factory provided controller system or triggered by a safety device, the unit shall shut down. Heating/cooling shall be disabled. After a time delay of 180 seconds (adj.), the fan shall be disabled. After a programmable time, delay (initially 30 seconds) the economizer dampers shall position to 100% return air.

6. Cooling Operation:

   a. Subject to startup and shutdown sequences and outdoor air lockout temperature, the cooling coil shall enable upon call for cooling from the discharge air temperature sensor. Cooling shall stage to maintain the discharge air temperature.
   b. During economizer operation, DX cooling operation shall not be enabled unless the economizer is at > 95%, and shall operate in sequence with the economizer as trim capacity to maintain calculated leaving air temperature set point.
   c. The cooling system controls shall modulate the compressor and the hot gas bypass circuit to dehumidify the air without overcooling the space.

7. Ventilation Control (RTU-3):

   a. CO_2 sensor, to be located on the wall in the associated space served by the unit.
   b. Factory provided control system shall continuously monitor the space CO_2 level. If the reading of the sensor is below 1200 PPM (adj.), the unit's outside air damper shall be positioned to supply the Minimum DCV OA Flow Rate (CFM) per the schedule.

   c. If the reading of the CO_2 sensors exceeds 1200 PPM (adj.), the outside air damper shall open from Minimum DCV OA Flow Rate (CFM) to the Maximum OA Flow Rate (CFM) at a rate of 1% damper position per 3 minutes until the CO_2 sensor reads below 900 PPM (adj.). Maximum OA Flow Rate (CFM) shall be per schedule.

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d. If the reading of the CO_2 sensor reads below 1100 PPM (adj.) and the OA reading is above the Minimum DCV OA Flow Rate (CFM) position, the damper shall close at a rate of 1% damper position per 3 minutes until the CO_2 sensor reads above 1200 PPM (adj.).

8. Economizer Operation:

a. The factory provided controller shall perform an enthalpy calculation to determine when it is more energy efficient to use outside air for cooling. The factory provided controller shall continually monitor the return air enthalpy, constantly comparing it to the outdoor air enthalpy. Based on the data and the enthalpy calculation the factory provided controller shall modulate the economizer damper to achieve mixed air temperature setpoint.
b. ENABLE (Comparative Enthalpy): Outside air (OA) enthalpy shall be compared with Return air (RA) enthalpy point. The economizer shall enable when OA enthalpy is less than RA enthalpy - 2.0 BTU/LB. The economizer shall disable when OA enthalpy is greater than RA enthalpy.
c. OPERATION: The supply air sensor shall measure the dry bulb temperature of the air leaving the evaporator coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the discharge air temperature falls below the discharge low limit temperature setpoint. Compressors shall be delayed from operating until the economizer has opened to 100%.
d. Economizer shall have a high limit shut off at 75ºF outdoor air temperature.
e. Whenever the economizer is locked out due to outdoor air conditions or there not a command for economizer cooling, the economizer shall modulate for calculated minimum ventilation air flow.
f. Whenever the economizer is operating, at no time shall the outside airflow rate as measured by the outdoor air flow station be allowed to drop below the calculated minimum ventilation rate.

9. Heating Operation:

a. Heating, cooling/economizer operation shall be controlled such that no overlap between heating and cooling operation takes place.
b. On call for heat from the discharge air temperature sensor, the discharge air temperature shall be set to 55°F, DX heating coil shall be controlled in sequence, to maintain a 55°F leaving air temperature. The VAV reheat coils shall operate to heat the air as needed on a zone by zone basis.

10. Supply Duct Static Pressure Control

a. During the occupied mode the unit controller shall modulate the output to the variable frequency drive as required to maintain the supply duct static pressure setpoint of 1.0 inches of W.C. (adj.). If the supply duct static pressure falls below 0.8 inches of W.C. (adj.) the unit controller shall increase the output to the variable frequency drive to maintain setpoint. If the supply duct static pressure rises above 1.2 inches of W.C. (adj.) the unit controller shall decrease the output to the variable frequency drive to maintain setpoint. Upon a call for heating or cooling in the

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unoccupied mode the unit controller shall modulate the speed of the variable frequency to maintain duct static pressure setpoint.

11. Refrigerant Mitigation Mode

a. The unit controller shall monitor the leak detection system, when a leak is detected, an alarm shall promptly alert and mitigation shall be activated.
b. In occupied mode, the supply fan shall remain operational, and the compressor(s), electric heating, fuel-fired heating, electrostatic devices, and any other ignition device starters shall be disabled, and activate mechanical ventilation (if it's required by Section 7.6.4 of the ASRAE standard). for the duration of the mitigation process plus an additional 5 minutes.
c. In unoccupied mode, the supply fan shall remain operational, and the compressor(s), electric heating, fuel-fired heating, electrostatic devices, and any other ignition device starters shall be disabled, and activate mechanical ventilation (if it's required by Section 7.6.4 of the ASRAE standard). for the duration of the mitigation process plus an additional 5 minutes.

B. Variable Air Volume Air Terminal Units (VAV)

1. Terminal VAV Boxes shall be controlled via factory provided controllers, independent of the RTU controls.

2. Terminal VAV Box, Cooling Only Control

The factory provided control system shall modulate variable volume damper in response to space temperature sensor fluctuation. When the space temperature exceeds the set-point, the variable volume damper shall modulate open. As the temperature falls the damper shall modulate to minimum position. A "High/Low" position limit may be implemented to limit the minimum and maximum air flow.

3. Terminal VAV Box, Electric Reheat Coil, Control

The factory provided control system shall modulate the variable volume damper and reheat coil in sequence to achieve the desired space temperature setpoint (adj.). When the space temperature exceeds the cooling setpoint (adj.), the variable air volume (VAV) damper shall modulate open. As the temperature falls, VAV damper modulates to minimum position. Minimum position shall be based on schedule on drawings. After damper reaches minimum position, the space temperature shall drift in a dead-band until reaching the heating control setpoint. As temperature continues to fall below setpoint, reheat coil shall modulate on. There are two modes of operation for setpoints, one for "occupied" and one for "unoccupied" mode.

4. Occupied Mode

The factory provided control system shall monitor the space temperature as sensed by its respective temperature sensor. Occupied mode shall be initiated based on the VAV airflow station detecting supply airflow entering the VAV.

Upon a demand for cooling the VAV box shall increase the airflow to its maximum setting to maintain the space setpoint of 75 degrees F (adj.).

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Upon a demand for heating the VAV box shall decrease the airflow to its minimum position and reheat coil shall modulate until the space approaches its temperature setpoint of 70 degrees F (adj.). If additional heat is required the setpoint shall be adjusted via the room temperature controller.

5. Unoccupied Mode

The VAV box damper shall remain in the closed position. Unoccupied mode shall be enabled when the VAV airflow station detects zero airflow entering the VAV.

B. ALARMS

1. Fan Failure

If status of a fan, which has been called by the factory provided control system to start, has not been verified as running within a period of 10 seconds (adj.), an alarm shall be initiated.

2. Filter Maintenance

A differential pressure switch with sensors on upstream and downstream side of filter shall signal the factory provided control system when the differential pressure is equal to or greater than the setpoint (adj.). The factory provided controller shall initiate an alarm signal indicating a clogged filter and requirement for maintenance.

3. Discharge air temperature

If the unit discharge air temperature is greater than 15 degrees F (adj) from setpoint the factory provided controller shall initiate an alarm.

4. Smoke Detector Alarm

If the smoke detector in the supply air duct has been activated, a signal, via hard wire interlock, shall shut down the supply fan immediately and send a signal directly to the fire alarm control panel, by others.

5. High Space Temperature Alarm

If the space temperature is offset by more than 5 degrees F (adj.) above setpoint for a period of 5 minutes (adj.) an alarm shall be initiated.

6. Low Space Temperature Alarm

If the space temperature is less than 5 degrees F (adj.) below setpoint for a period of 5 minutes (adj.) an alarm shall be initiated.

7. Condensate Pan Level Alarm

A conductivity probe assembly shall be provided in the air handling unit condensate pan to detect the level of condensate in the coil drain pan. In the event that the level of the condensate rises above the probe's detection mechanism, an alarm shall be initiated.

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1.5 TERMINAL UNIT CONTROL SEQUENCES

A. Exhaust fans (EF):

1. Exhaust Fan (General, Toilet Rooms): The exhaust fan shall be controlled via a factory provided controller). During the occupied mode, the exhaust fans shall be started and shall run continuously. Any associated dampers shall be open.

PRODUCTS (Not Applicable)

PART 2 - EXECUTION (Not Applicable)

END OF SECTION 230993

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SECTION 232923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, wiring diagrams, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

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1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Product Certificates: For each VFC from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.
c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

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f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: An 18-month warranty shall be provided on materials and workmanship from the date of shipment.

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PART 2 - PRODUCTS

2.1 SUMMARY

A. This section provides specification requirements for solid-state, pulse-width modulated (PWM) Adjustable Frequency Drives, herein referred to as AC Drives, for use with NEMA® design NEMA B AC motors, or standard IEC motors.

B. The AC Drive supplier shall furnish, field test, adjust and certify all installed AC Drives for satisfactory operation.

C. Any exceptions/deviations to this specification shall be indicated in writing and submitted no less than one week prior to bid date.

2.2 REFERENCES

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®).

B. UL 508 - UL Standard for Safety Industrial Control Equipment.

C. UL 508C - UL Standard for Safety Power Conversion Equipment.

D. NEMA ICS7 : Industrial Control and Systems Variable Speed Drives.

E. CSA C22.2 No. 14-M91 : Industrial Control Equipment

F. IEC 1800 : Adjustable speed Electrical power drive systems

G. SEMI-F47: Voltage Ride Thru

2.3 GENERAL DESCRIPTION

A. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage

B. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage.

C. The output power section shall change fixed DC voltage to adjustable frequency AC voltage.

D. The adjustable frequency drive package shall include input EMI/RFI filtering.

E. The AC drive shall have a user interface (keypad) that presents information in plain English / Spanish / French text. The user interface shall include a Local / Remote button to switch between control at the terminal strip and the user interface (keypad). This button shall also switch between network control and the user interface (keypad). The keypad shall have Run and Stop keys and a manual speed potentiometer function.

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2.4 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:

1. Schneider Electric USA, Inc Square D. (Basis of Design)
2. ABB
3. Eaton Electrical Inc: Cutler Hammer business unit

2.5 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.6 CONSTRUCTION

A. The AC Drive power converter shall be UL Plenum rated.

1. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

B. All heat sink fans shall be accessible from the front and shall not require the removal of the AC drive power converter for fan replacement.

C. All heat sink fans shall be cycled on only when required to cool the drive to maximize the life of the fan

D. When a Type 12 conduit entrance kit is required. The kit shall attach and be ground to the bottom of the AC drive and provide conduit landing for incoming line power cables, motor lead cable, control wiring, and network cabling.

2.7 APPLICATION DATA

A. The AC Drive shall be sized to operate a variable torque load.

B. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 72 Hz.

2.8 ENVIRONMENTAL RATINGS

A. The AC Drive shall meet IEC 60664-1 Annex A and NEMA ICS 1, UL, and CSA standards.

B. The AC Drive shall be designed to operate in an ambient temperature from -10 to 50 ˚C (14 to 122 ˚F).

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C. AC Drives in Type 12 enclosures shall be designed to operate in an ambient temperature from -10 to 40 ˚C (14 to 104 ˚F).

D. Provide internal heaters as required to provide operation down to 0 degrees F.

E. The storage temperature range shall be -25 to 65 ˚C (-13 to 149 ˚F).

F. The maximum relative humidity shall be 95%, non-condensing.

G. The AC Drive shall be rated to operate at altitudes less than or equal to 3300 ft (1000 m).

H. For altitudes above 3300 ft (1000 m), the AC Drive should be de-rated per drive specifications.

I. The AC Drive shall meet the IEC 60721-3-3-3M3 operational vibration specification.

2.9 RATINGS

A. The AC Drive shall be designed to operate at the input line voltage indicated on the equipment schedule.

B. The AC Drive shall operate from an input frequency range of 60 Hz (±) 5%.

C. The displacement power factor shall not be less than .98 lagging under any speed or load condition.

D. The efficiency of the AC Drive at 100% speed and load shall not be less than 97%.

E. The variable torque rated AC Drive over current capacity shall be not less than 110% for 1 minute.

F. The output carrier frequency shall be randomly modulated about the selected frequency. The output carrier frequency of the AC Drive shall be selectable from 1 to 16 kHz, 12kHz nominal rating for 1-60 hp @ 200/240 V, 1-100 hp @ 380/480 V. Selectable: 2.5 to 8 kHz, 2.5kHz nominal rating for 75-125 hp @ 200/240 V, 125-900 hp @ 380/480 V.

2.10 PROTECTION

A. Upon power-up, the AC Drive shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, DC-to-DC power supply, control power and pre-charge circuit.

B. The AC drive shall be rated for UL minimum short circuit currents per given horsepower rating.

C. The AC Drive shall be protected against short circuits, between output phases and to ground.

D. The AC Drive shall have under-voltage power-loss ride through performance per the SEMI F-47 voltage ride through standard and certified by a third party.

E. The AC drive shall have a programmable ride-through function, which will allow the logic to maintain control for a minimum of one-second (60 cycles) without faulting.

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F. An auto restart function will provide selectable time for restart attempts after the fault has disappeared and other operating conditions permit the restart. The restart shall be performed by a series of automatic attempts separated by increasingly longer periods of time. This period of time shall be selectable.

G. Upon loss of the analog process follower reference signal, the AC Drive shall be programmable to display a fault.

H. The AC Drive shall have a solid-state UL 508C listed overload protective device and meet IEC 60947.

I. The output frequency shall be software enabled to fold back when the motor is overloaded.

J. There shall be three skip frequency ranges that can be programmed to a bandwidth of ± 2.5 Hz.

2.11 ADJUSTMENTS & CONFIGURATIONS

A. The AC Drive shall be capable of storing the configuration in the keypad.

B. The acceleration and deceleration ramp times shall be adjustable from 0.05 to 999.9 seconds.

C. The memory shall retain and record run status and fault type of the past eight faults.

D. The software shall have an energy economy function that, when selected, will reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load. Selectable volts/Hz ratio patterns does not meet specification, the function must be automatically optimized.

E. The AC Drive shall have macro configurations for HVAC and pump applications, PID regulator set-up and network set-up.

2.12 KEYPAD DISPLAY INTERFACE

A. A keypad display interface shall offer the modification of AC Drive adjustments through a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, and adjustment storage, and diagnostics shall be accessible.

B. The AC Drive model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall be listed on the drive identification portion of the LCD display.

C. The keypad display shall have password protection that allows the keypad to be locked out from unauthorized personnel.

D. The keypad shall be capable of displaying I/O assignment and status.

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2.13 CONTROL CONNECTIONS

A. The control power for the digital inputs and outputs shall be 24Vdc.

B. The internal power supply shall incorporate automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and will not be damaged if shorted.

C. Removable terminal strips shall be used on all logic and analog signal connections in the power converter.

D. Two voltage-free relay output contacts will be provided. One of the contacts will indicate AC Drive fault status. The other contact shall indicate a drive run status. These relays shall be configurable for other status indicators.

E. The AC drive shall have a power removal logic input. The drive shall not allow the motor to operate until this input is closed. If this input is opened while the connected motor is running, the AC drive shall stop applying power to the motor. This power removal function shall be certified by an independent agency.

F. The control section of AC drive shall be supplied separately if necessary with 24V DC, to keep the network communication always available even if the power supply is OFF.

G. The drive shall include a damper solenoid end switch. Switch closure to be made prior to fan being energized.

H. Provide with preset speed input to accommodate high speed operation from auxiliary 24 V signal

2.14 SERIAL COMMUNICATION

A. The AC Drive shall have an integrated RJ45 port, selectable for Modbus or CanOpen.

B. The AC drive shall have the capability for internal mounted communication card. The following protocols shall be the minimum available :

Industrial Installations	HVAC building Installations
- Ethernet TCP/IP - Modbus Plus - FIPIO - Profibus DP - Device Net - InterBus-S	-Lonworks -BACnet

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2.15 HARMONIC MITIGATION

A. Each drive shall include a combination of integrated filters and DC link reactors to provide effective harmonic mitigation equivalent to 3% impedance without requiring additional panel space.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that the location is ready to receive work and the dimensions are as indicated.

3.2 PROTECTION

A. Before and during the installation, the AC Drive equipment shall be protected from water and site contaminants.

3.3 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Comply with NECA 1.

D. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

E. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

F. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

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G. The AC Drive supplier shall provide a representative to inspect the contractor's installation, test and start-up the AC Drive(s) furnished under this specification.

3.4 DOCUMENTATION

A. The AC Drive supplier shall supply a comprehensive bound instruction and installation manual that includes wiring diagrams, layout diagrams, and outline dimensions. This manual must be insertion in a shop manual supplied by the installing contract.

3.5 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

B. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

C. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

D. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range] [66 Hz, with torque constant as speed changes; maximum voltage equals input voltage.

E. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

F. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.

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4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.
9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.

H. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

J. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

K. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

3.6 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.

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5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

2. Output Signal Interface: A minimum of one programmable analog output signal(s) 4- to 20-mA dc, which can be configured for any of the following:

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a. Output frequency (Hz).
b. Output current (load).
c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

3. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

F. BAS Interface: Factory-installed hardware and software shall interface with BAS to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

a. Monitoring: On-off status.
b. Control: On-off operation.

3.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

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D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.10 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

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E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineerbefore starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.12 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.13 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

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B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

3.14 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.15 DEMONSTRATION

A. Train owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct Liners.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Volume Four and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Structural Performance: Hangers and supports for ductwork shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

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2. Sealants and gaskets.

1.5 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

1. Lined ductwork
2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Factory- and shop-fabricated ducts and fittings.
4. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
5. Ceiling devices and associated airflow rates.
6. Elevation of top of ducts.
7. Dimensions of main duct runs from building grid lines.
8. Fittings.
9. Reinforcement and spacing.
10. Seam and joint construction.
11. Penetrations through fire-rated and other partitions.
12. Equipment installation based on equipment being used on Project.
13. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
14. Hangers and supports, including methods for duct and building attachment and vibration isolation.
15. Sheet metal thicknesses

B. Coordination Drawings: Plans and other details, drawn to scale, on which components are shown and coordinated with each other, using input from installers of the items involved.

C. Welding certificates.

D. Field quality-control reports

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

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PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" volume four based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams,"

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for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Flexible Elastomeric Noise Reducing Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armacell LLC, Coilflex.
   b. Aeroflex USA Inc
   c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Minimum thermal conductivity: .25 BTU-in/h-ft^2-F
4. Rated for 180 degree F max and -297 degree F min
5. Noncorrosive

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6. Antimicrobial
7. Sound transmission rating: 25
8. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. **Adhere to duct with adhesive and secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally**.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.

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3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

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B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

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K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. All ductwork: Seal class A

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2,

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"Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 2-Inch wg: Test representative duct sections no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give fourteen days' advance notice for testing.

C. Duct System Cleanliness Tests:

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1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

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1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply, Return, Exhaust, and Outside Air:

   a. Pressure Class: Positive 3-inch wg Negative 2- inch wg
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round: 24

C. Intermediate Reinforcement:

   1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

D. Liner:

   1. Air Ducts specifically identified with an “L” after the duct size on drawings:

      a. Flexible elastomeric noise reducing duct liner: 1 inches thick

E. Elbow Configuration:

   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

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a. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity up to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.

b. Round Elbows, 8 Inches and Smaller in Diameter: Stamped.
c. Round Elbows, 10 Inches and Larger in Diameter: 5 Gore, Welded.

A. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree lateral or 90-degree with 45-degree entry.

2. Rectangular Main to Round Tap: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 2000 fpm or Less: 45-degree lateral or 90-degree with 45-degree entry.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Duct accessory hardware
10. Flexible ducts.

1.3 ACTION SUBMITTALS

A. Product data

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

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1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and 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. Fusible Links: Furnish 1 for each damper requiring fusible links installed

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and a No.3 finish for exposed ducts

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. 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

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2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:

1. Description: Gravity balanced.
2. Maximum Air Velocity: 2500 fpm.
3. Maximum System Pressure: 2-inch wg.
4. Temperature: 180 degrees F
5. Frame: 18 gauge galvanized sheet steel, 3.5 in wide with welded corners and mounting flange.
6. Blades: .025 in thick roll-formed aluminum, center-pivoted, with sealed edges.
7. Blade Action: Parallel.
8. Blade Seals: extruded vinyl
9. Blade Axles:

    a. Material: Plated steel.
    b. Diameter: .1875 in

10. Tie Bars and Brackets: 20 gauge galvanized steel (on-blade)
11. Return Spring: Adjustable tension.
12. Bearings: Acetal.
13. Accessories:

    a. Adjustment device to permit setting for varying differential static pressure

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: provide products by one of the following:

    a. Greenheck Fan Corporation
    b. Nailor Industries Inc.
    c. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped, 16 gauge, 5 inch deep, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Single blade up to 12” high, multi blade over 12” high
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.

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d. Galvanized, V-blade, 16 gauge but not less than two gauges more than the duct gauge

6. Blade Axles: Galvanized steel, ½ inch diameter.
7. Bearings:

a. Stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 2-inch wg or more and on all dampers over 12 inch diameter shall have continuous rod axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.
9. Include elevated platform for insulated duct mounting.
10. Damper handles:

a. Cast alloy body and core
b. Heavy stamped handle
c. Locking
d. Hex locking nut and acorn nut
e. Basis of design: Duro Dyne, Specline or approved equal

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK
2. Greenheck Fan Corporation.
3. Ruskin Company.

B. Fire Dampers (Curtain Style):

1. Type: Static; rated and labeled according to UL 555 by an NRTL.
2. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
3. Fire Rating: 1-1/2 hours.
4. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
5. Mounting Sleeve: Factory installed galvanized sheet steel. Provide with breakaway duct connections.

a. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
b. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

6. Mounting Orientation: Vertical or horizontal as indicated.
7. Blades: Galvanized curtain style
8. Heat-Responsive Device: Replaceable, 165 [212] deg F rated, fusible links.

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C. Fire Dampers (Airfoil Style):

1. Type: Static [Dynamic]; rated and labeled according to UL 555 by an NRTL.
2. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
3. Fire Rating: 1-1/2 [3] hours.
4. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
5. Mounting Sleeve: Factory installed, galvanized sheet steel. Provide with breakaway duct connections.

    a. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
    b. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

6. Mounting Orientation: Vertical or horizontal as indicated.
7. Blades: Roll-formed, interlocking 0.024 inch thick galvanized sheet steel.
8. Heat-Responsive Device: Replaceable, 165 [212] deg F rated, fusible links.

2.6 FLANGE CONNECTORS

A. Interior

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ductmate Industries, Inc.
    b. Nexus PDQ; Division of Shilco Holdings Inc.
    c. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
3. Material: Galvanized steel.
4. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

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B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single Wall for ducts up to 36 inches wide and double wall for larger dimensions.

E. Vane Spacing: 1.5 inches.

F. Vane Radius: 2 inches.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
b. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
c. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.

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3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch thick, fibrous-glass or polystyrene-foam board

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.11 FLEXIBLE DUCTS

A. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:

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B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

C. Flexible ducts to be provided for supply air ductwork only or as otherwise shown on drawings.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at outlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Provide volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Dampers shall be provided as necessary to achieve a NEBB certified air balance.

1. Install steel volume dampers in steel ducts.
2. Install stainless steel volume dampers in stainless steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Remote volume damper operator: Install where volume dampers are shown on contract documents above inaccessible ceiling. Operator shall be adjustable by removing 1” screw cap. Rack and pinion controller mounted to “C” bracket. Bracket shall fasten to a ceiling support stud above the ceiling. Airflow adjustment tool shall be provided, one tool per 10 operators.

G. Remote control damper operator: Install where volume damper as shown on contract documents above inaccessible ceiling. Install terminal wall point and connect RJ-11 cable between damper and terminal point. Support wire per division 26 ‘Wiring’ sections. Group terminal points at single location as practical, review terminal point location(s) with Engineer or Owner’s Representative.

H. Install test holes at fan inlets and outlets and elsewhere as indicated.

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I. Install fire dampers according to UL listing.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. At outdoor-air intakes and mixed-air plenums.
3. At drain pans and seals.
4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
5. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
6. Upstream and downstream from turning vanes.
7. Upstream or downstream from duct silencers.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped in place with stainless steel band clamps.

R. Connect flexible ducts to metal ducts with stainless steel band clamps, adhesive, and sheet metal screws.

S. Install duct test holes where required for testing and balancing purposes.

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3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.
6. Verify all dampers are secured and handles can be correctly fastened to hold damper in place.

END OF SECTION 233300

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof Downblast Centrifugal Exhaust Fans

B. Related Sections:

1. Section 230010 “Common Motor Requirements for HVAC Equipment.”
2. Section 237200 “Roof Accessories.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators

C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 DIRECT DRIVE ROOF DOWNBLAST CENTRIFUGAL EXHAUST FANS

A. General Description:

1. Downblast fan shall be for roof mounted applications
2. Performance capabilities up to 14,500 cubic feet per minute (cfm) and static pressure to 2.75 inches of water gauge
3. Fans are available in twenty sizes with nominal wheel diameters ranging from 8 inches through 30 inches (071 - 300 unit sizes)
4. Maximum continuous operating temperature is 180 Fahrenheit (82.2 Celsius)
5. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

B. Wheel:

1. Constructed of aluminum
2. Non-overloading, backward inclined centrifugal
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

C. Motors:

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1. Electronically Commutated Motor

    a. Motor enclosures: Open type
    b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
    c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
    d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
    e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    f. Motor shall be a minimum of 85% efficient at all speeds.

D. Housing:

1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
2. Shroud shall have an integral rolled bead for extra strength
3. Shroud shall be drawn from a disc and direct air downward
4. Lower windband shall have a formed edge for added strength
5. Motor cover shall be drawn from a disc
6. All housing components shall have final thicknesses equal to or greater then preformed thickness.
7. Curb cap shall have pre-punched mounting holes to ensure correct attachment
8. Rigid internal support structure
9. Leak proof

E. Housing Supports and Drive Frame:

1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators

F. Vibration Isolation:

1. Rubber isolators
2. Sized to match the weight of each fan

G. Disconnect Switches:

1. NEMA-1 rated
2. Positive electrical shut-off
3. Wired from fan motor to junction box installed within motor compartment

H. Options/Accessories:

1. Birdscreen:

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a. Material Type: Galvanized
b. Protects fan discharge

2. Roof Curbs:

a. Provide wind rated roof curb in accordance with Section 237200.

3. Dampers:

a. Type: Motorized
b. Prevents outside air from entering back into the building when fan is off
c. Balanced for minimal resistance to flow
d. Galvanized frames with prepunched mounting holes

2.2 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

C. Install units with clearances for service and maintenance.

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D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.

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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 there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. 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.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor, and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

F. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

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SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-duct air terminal units.
2. Casing Liner.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Refer to specification section 230010 “General Mechanical Requirements” for further information on coordination drawings.

B. Field quality-control reports.

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1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. O&M information shall include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Insulation shall meet NFPA 90A requirements for flame spread and smoke generation and UL 181 requirements for anti-erosion, corrosion and fungus properties. Any sealant used shall also conform to NFPA 90A and be approved for duct use.

D. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

E. Sound power levels shall be AHRI certified in accordance with the requirements of AHRI 880.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Unless otherwise indicated within the specification, and subject to compliance with requirements, provide products by one of the following:

1. Trane (Basis of Design)
2. Price Industries.
3. Titus.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

2.3 SINGLE-DUCT AIR TERMINAL UNITS

A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

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B. Casing: 20 gauge galvanized steel, single wall.

1. Casing Liner: Comply with requirements in "Casing Liner" Article for duct liner.
2. Air Inlet: Product and material, appropriate for the metal gauges being joined, the maximum pressure, and SMACNA recommendations, to result in a rigid, leak-free duct connection. All connections shall be sealed using an appropriate duct sealant method unless a slide-on transverse duct connector sold with a guaranteed leak-free sealing feature is used.
3. Air Outlet: Product and material, appropriate for the metal gauges being joined, the maximum pressure, and SMACNA recommendations, to result in a rigid, leak-free duct connection. All connections shall be sealed using an appropriate duct sealant method unless a slide-on transverse duct connector sold with a guaranteed leak-free sealing feature is used.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket. Access door located on the bottom of the terminal.
5. Leakage through the casing shall be less than 1% of the maximum rated air flow at 3" w.c. static pressure.

C. Casing Liner: 1-inch thick (min. R-4.2) rigid duct board insulation with nylon reinforced foil material covering the insulation fibers. Insulation shall meet UL 181 and NFPA 90A. The lining shall be attached to the terminal unit casing by insulation adhesive and full seam length steel Z-strips which enclose and seal the insulation cut edges. Taped edges shall not be accepted.

D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from 0 - 140ºF, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.

E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, less than 2% of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Nominal 90-degree, free rotation from fully opened to fully closed positions when mechanical stops are. The damper blade shall be mechanically attached to the die-cast metal damper shaft with through the shaft machine-applied rivets. The low leakage damper shall be constructed of a gasket material sandwiched between two 22-gauge zinc coated steel plates. The damper gasket material shall be securely fastened between the two damper plates using machine applied rivets. The damper assembly shall rotate freely in self-lubricating bearings. Damper position shall be indicated on the end of the shaft on the outside of the casing. Free rotation until factory-installed stops reached.

F. Attenuator Section: 20 gauge steel sheet.

1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for duct liner.

G. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and

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secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. SCR controlled.
2. Access door interlocked with disconnect switch.
3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
4. Nickel chrome 80/20 heating elements.
5. Airflow switch for proof of airflow.
6. Fan interlock contacts.
7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
8. Mercury contactors.
9. Magnetic contactor for each step of control (for three-phase coils).

H. Control devices shall be compatible with roof top unit integral factory control system.

1. Electronic Damper Actuator: 24 V, powered open, spring return.
2. Electronic Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
4. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

    a. Occupied and unoccupied operating mode.
    b. Remote reset of airflow or temperature set points.
    c. Adjusting and monitoring with portable terminal.

5. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

I. Controls:

1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

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PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install chemical-actuated concrete fasteners after concrete is placed and completely cured.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal unit(s) level and plumb. Maintain ready accessibility for routine service and maintenance. Unit shall be accessible within the reach of an 8-foot step ladder. Access shall not be hindered by building components. No maintainable parts of the unit, reheat coil, or appurtenance shall be crossed by a wall.

C. Install wall-mounted temperature sensors.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Connect ducts to air terminal units according to Section 233113 "Metal Ducts”.

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

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1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service:

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that the building management system display accurately reflects the as-built condition and that the building management system responds and causes the terminal unit to respond as specified.
7. Verify that the identified terminal unit serves the area specified on the final drawings.

3.7 DEMONSTRATION

A. Train owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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. Ceiling diffusers.
2. Linear slot diffusers.
3. Fixed face registers and grilles.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATION SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

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PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Ceiling Diffusers:

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Devices shall be specifically designed for variable-air-volume flows.
3. Construction: Precision formed back cone of one-piece seamless construction that incorporates a round Intel collar of sufficient length for connecting rigid or flexible duct.
4. An inner plaque assembly shall be incorporated and shall drop no more than a ¼ inch below the ceiling plane to assure proper air distribution performance.
5. The inner plaque assembly shall be completely removable from the diffuser face to allow for full access to any dampers or other ductwork components located near the diffuser neck.
6. Material: Refer to drawings.
7. Finish: powder coat, color selected by Architect.
8. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering per ASTM D610 and ASTM D714.
9. Air pattern: 360 degree radial horizontal.
10. Face Size: Indicated on drawing per location.
11. Face Style: Plaque.
12. Mounting: Coordinate with architectural ceiling types for each diffuser shown and provide mounting frame specific for each ceiling type.
13. Dampers: Radial opposed blade.
14. Accessories:

    a. Equalizing grid.

2.2 LINEAR SLOT DIFFUSERS

A. Linear Slot Diffuser:

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Devices shall be specifically designed for variable-air-volume flows.
3. Construction: The diffuser border shall be heavy extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps or angle end caps.
4. Joiner strips shall be provided to align continuous slot assemblies.
5. Finish - Face and Shell: Powder coat, color selected by Architect.
6. Finish - Pattern Controller: Powder coat, black.
7. Finish - Tees: Powder coat, color selected by Architect.
8. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering per ASTM D610 and ASTM D714
9. Slot: ¾” wide with aerodynamically curved “ice tong” shaped pattern control.

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10. Number of Slots: Indicated on drawings per location.
11. Length: Indicated on drawings per location.
12. Air pattern: 180 degree adjustable horizontal
13. Accessories:

    a. Factory fabricated and insulated plenum box sized for the length of the diffuser.

        1) Construction: zinc coated steel
        2) Plenum assemblies shall be of a side inlet configuration
        3) Plenum shall have sloped shoulders for enhanced spread characteristics.
        4) Provide curved factory built plenums to accommodate curved diffuser

14. Coordinate with architectural ceiling types for each linear slot outlet shown and provide mounting frame specific for each ceiling type.

2.3 FIXED FACE REGISTERS AND GRILLES

A. Fixed Face Supply Register

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced ¾ inch on center. The front blades shall run parallel to the long dimension of the register.
3. Material: Refer to drawings.
4. Finish: Powder coated, color selected by Architect.
5. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering per ASTM D610 and ASTM D714
6. Frame: 1-1/4 inches wide.
7. Mounting Frame: Welded with precision mitered corners.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade. Damper shall be operable from the register face. Damper material to match register material.

B. Fixed Face Return and transfer Register

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Registers shall be 45 degree deflection fixed louver type with blades spaced ½ inch on center. The front blades shall run parallel to the long dimension of the register.
3. Material: Refer to drawings.
4. Finish: Powder coated, color selected by Architect.
5. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering per ASTM D610 and ASTM D714
6. Frame: 1-1/4 inches wide.
7. Mounting Frame: Welded with precision mitered corners.
8. Mounting: Countersunk screw.

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9. Damper Type: Adjustable opposed blade. Damper shall be operable from the register face. Damper material to match register material.

C. Fixed Face Exhaust Register

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Registers shall be 45 degree deflection fixed louver type with blades spaced ½ inch on center. The front blades shall run parallel to the long dimension of the register.
3. Material: Refer to drawings
4. Finish: Powder coated, color selected by Architect.
5. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering per ASTM D610 and ASTM D714
6. Frame: 1-1/4 inches wide.
7. Mounting Frame: Welded with precision mitered corners.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade. Damper shall be operable from the register face. Damper material to match register material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

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END OF SECTION 233713

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SECTION 237200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Duct supports.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Delegated Design: Design roof accessories and associated anchors including comprehensive engineering analysis signed and sealed by a qualified professional engineer, licensed in the project location state, responsible for their preparation. Wind pressures are to be determined by delegated design engineer based on site specific wind criteria indicated below. All building attachments to be coordinated with structural conditions.

1. Detail fabrication and assembly of rooftop unit and roof curb.
2. Wind Design Loads:

    a. Basic wind speed: 105 MPH
    b. Exposure Category: C

        1) Refer to structural drawing S001 for additional structural design data.

B. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance: Equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

C. Detail mounting, securing, and flashing of roof curb to roof structure and unit to roof curb. Indicate coordinating requirements with roof membrane system

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Greenheck Fan Corporation.
    b. Pate Company.
    c. Thybar Corporation (Basis of Design).

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

1. See wind load requirements in Part 1 above.

D. Material: Zinc-coated (galvanized) steel sheet, 18-gauge thick.

E. Construction:

1. Curb Profile: compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 24 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloped deck-mounting flange.

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5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant**,** and integrally formed structure-mounting flange at bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pate Company. (Basis of Design).
    b. Thybar Corporation.
    c. Custom Solution Roof and Metal Products

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Material: Zinc-coated (galvanized) steel sheet,14-gauge thick.

E. Construction:

1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 5-1/2 inches wide under top flange on side of curb, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.

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6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

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1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Gravity Ventilator Installation: Verify that gravity ventilators operate properly and have unrestricted airflow. Clean, lubricate, and adjust operating mechanisms.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 237200

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SECTION 237414 – PACKAGED ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Section 230010- “General Motor Requirements for HVAC Equipment”

C. Division 26 Section 232923- “Variable Frequency Drives”

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components:

1. Air-source heat pump heating and cooling.
2. Economizer outdoor- and return-air damper section.
3. Power exhaust fan.
4. Air filtration.
5. Roof curbs.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design rooftop fans, roof curbs, and associated anchors including comprehensive engineering analysis signed and sealed by a qualified professional engineer, licensed in the project location state, responsible for their preparation. Design to include rooftop fan, roof curb, and all associated anchors and fastener performance requirements. Wind pressures are to be determined by delegated design engineer based on site specific wind criteria indicated below. All building attachments to be coordinated with existing structural conditions.

1. Detail fabrication and assembly of fan and roof curb.
2. Wind Design Loads:

B. Wind-Restraint Performance:

1. Ultimate Wind Speed: 105 mph.
2. Exposure Category: C.

C. Structural Performance: Equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

D. Detail mounting, securing, and flashing of roof curb to roof structure and unit to roof curb. Indicate coordinating requirements with roof membrane system

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1.4 ACTION SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.
    e. Wiring diagrams

4. Certified coil-performance ratings with system operating conditions indicated.

5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring

C. Delegated-Design Submittal: For unit supports indicated above

1.5 INFORMATIONAL SUBMITTALS

A. Certificates: For certification required in "Quality Assurance" Article.

B. Field quality-control reports.

C. StaMAUp service reports.

D. Warranty: Sample of special warranty

E. Coordination Drawings: Plans and other details, drawn to scale, on which components are shown and coordinated with each other, using input from installers of the items involved. Refer to Specification Section 2300100 General Mechanical Requirements for further information.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of start-up filters, one set of replacement filters, and 1 set of extra filters for each unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience.

B. The product shall be provided by a single manufacturer.

C. The manufacturer authorized representative shall be factory trained and certified personnel providing service, start up, and quality control field labor for the project from their local office.

D. All components shall be factory tested and documented to operate as a complete system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

G. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

H. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and StaMAUp."

I. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

J. Units shall be manufactured in an ISO 9001 certified facility.

K. Units shall be CSA certified to ANSI Z21.47 and UL 1995/CAN/CSA No. 236-M90 standards

L. Comply with NFPA 70.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

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1.10 WARRANTY

1. Provide 1-year parts and labor warranty associated with all components of the air handling unit. Warranty period to begin at substantial completion.
2. Compressor- 5 years from substantial completion.
3. Heat Exchanger- 10 years from substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane. (Basis of Design)
2. York.
3. Carrier.

2.2 GENERAL

A. Unit shall be fully assembled and tested by the manufacturer in the factory in accordance with the arrangement shown on the drawings. Fans shall be tested and rated in accordance with AMCA Standard 210 or performance and in accordance with ANSI standards of testing for sounds power levels.

B. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit. Unit manufacturer shall furnish unit with sufficient gasket and bolts for reassembly in the field.

C. The unit manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Architect. If a local representative cannot be provided, the manufacturer shall provide a factory representative.

2.3 PACKAGED ROOFTOP UNITS

A. GENERAL

1. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment’s literature pocket.

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2. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
3. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
4. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
5. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
6. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
7. Cooling capacity ratings shall be based on ARI Standard 210. Units shall consist of insulated weather-tight casing with compressors, air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls and drives.
8. The units shall be factory wired, piped and charged with R-454B refrigerant and factory tested prior to shipment.
9. Units meet the seismic capacity requirements of the International Code Council Evaluation Service (ICC- ES) document AC156 (Acceptance Criteria for Seismic Qualification by Shake- Table Testing of Nonstructural Components and Systems), the International Building Code (IBC 2009), and the California Building Code (CBC 2010) with quality testing conducted in accordance with the standards of the American Society of Civil Engineers (ASCE 7-05).

    a. Units are certified with an SDS (g) value of 2.50 using seismic design parameters of z/h=1.0, Ip=1.5 and certified by independent structural engineers

B. UNIT CASINGS

1. Cabinet: Galvanized steel. Exterior surfaces shall be finished with a non-chalking, powder paint finish.
2. Unit cabinet surface shall be tested 672 hours in salt spray test in compliance with ASTM B117.
3. Cabinet construction shall allow for all service/maintenance from one side of the unit.
4. Cabinet top cover shall be one-piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
5. Access Panels: Hinged, tool-less access panels shall be provided for the control box, compressors, filters, indoor motor & blower, and the heating section.
6. Insulation: Provide up to 1 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
7. All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.
8. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.
9. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils.
10. Condensate pan shall be slide out design, constructed of a non-corrosive material, internally sloped and conforming to ASHRAE 62-B9 standards.

C. AIR FILTERS

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1. Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Two-inch thick pleated MERV-8 and MERV-13 filters shall be furnished and installed.

D. FANS AND MOTORS

1. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
2. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
3. Entire blower assembly and motor shall be slide out design.
4. Outdoor and Indoor Fan motors shall be permanently lubricate and have internal thermal overload protection.
5. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
6. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

E. EVAPORATOR COIL

1. Evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed.
2. Evaporator coils shall be of the direct expansion, draw-thru design.
3. Refrigerant Circuit and Refrigerant Safety Components shall include:

    a. Independent fixed-orifice or thermally operated expansion devices.
    b. Solid core filter drier/strainer to eliminate any moisture or foreign matter.
    c. Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.
    d. The unit shall have two independent refrigerant circuits, equally split in 50% capacity increments.

F. CONDENSER SECTION

1. Condenser coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins.
2. Condenser coils shall be of the draw-thru design.
3. The outdoor fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The outdoor fan motors shall have permanently lubricated bearings internally protected against overload conditions and staged independently.
4. Provide factory hail guards.

G. REFRIGERANT SYSTEM

1. Unit shall be factory charged with R-454B refrigerant.
2. Compressors: Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction

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gas cooled and have a voltage range of + or – 10% of the unit nameplate voltage. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.

3. Units shall have cooling capabilities down to 0 degree F as standard.
4. Units shall have heating performance shall be based on 47 degree F outside air temperature at 70% relative humidity.
5. Provide each unit with refrigerant circuits factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports

H. DEHUMIDIFICATION

1. Factory installed and provide dehumidification of an occupied space while maintaining temperature control utilizing a hot gas reheat coil.

    a. Determination of unit functionality in straight cooling, straight heating, or reheat mode shall come from standard control board.
    b. Reheat mode shall utilize a specific reheat coil placed after the evaporator coil to heat the conditioned air back to a neutral temperature when the occupied space requires dehumidification, but the temperature requirements are satisfied.
    c. The reheat circuit shall utilize solenoids to alter the refrigerant flow from being directed through the condenser circuit to the hot gas reheat circuit.
    d. Changeover from cooling mode to reheat mode shall be accomplished in 30 seconds or less.

2.4 POWERED EXHAUST

1. Provide a factory installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.
2. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0- 100% adjustable set point on the economizer control.

2.5 OUTDOOR AIR SECTION

1. Provide a fully integrated 100% modulating outside air economizer with outdoor and return air dampers.

    a. The maximum leakage rate for the outdoor air intake dampers shall be designed to meet ASHRAE 90.1-2010, AMCA 511 Class 1A damper, and the International Energy Conservation Code (IECC) certification requirements by achieving leakage rates of 3 cfm/sq. ft. at 1" of static pressure.
    b. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feeds input into the basic module.
    c. Provide ability for simultaneous economizer/compressor operation.
    d. Outside air dampers shall fully close on power loss.

2. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit. Water eliminator/filters shall be provided.
3. Provide power exhaust with barometric relief damper.

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2.6 CONTROLS

1. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
2. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor:

    a. Loss-of-charge/Low-pressure switch.
    b. High-pressure switch.
    c. Freeze condition sensor on evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.

3. Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.
4. Unit control board shall have on-board diagnostics and fault message display on.
5. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to a selectable value as low as 0 °F.
6. Control board shall monitor each refrigerant safety switch independently.
7. Microprocessor Control System:

    a. Configured to communicate with multiple BAS communication protocols to integrate with building automation systems. Protocols supported include: BACnet®, MS/TP, Modbus®, and N2 communication
    b. Temperature Sensors: Factory installed supply air, return air, and outdoor air temperature sensors.
    c. On-board USB Port: Provide access to data logging, current and previous system faults and software update capabilities using the on board USB port and common flash drive.
    d. Embedded LCD Display: Include built-in LCD display and easy to use navigation joystick and buttons allowing the user to quickly navigate the menus displaying unit status, options, current function, supply, return and outdoor temperatures, fault codes and other information.
    e. Safety Monitoring: Monitors outdoor, supply, and return air temperatures and the high and low pressure switch status on the independent refrigerant circuits. Monitor gas valve and high temperature limit switches on gas and electric heating units. Monitor the voltage supplied to the unit and will protect the unit if low voltage due to a brown out, or other electrical issue occurs.
    f. Low Ambient: Integrated low-ambient control allows units to operate in the cooling mode down to 0°F outdoor ambient without additional components or intervention. Optionally, the control board can be programmed to lockout the compressors when the outdoor air temperature is low or when free cooling is available.
    g. Anti-Short Cycle Protection: Provide compressor anti-short cycle delay is and programmable minimum run times. Provide temporary override of anti-short cycle delay via push of a button for testing.
    h. Fan Delays: Provide fully programmable independent heating and cooling fan on and fan off delays.
    i. Nuisance Trip Protection and Three Strikes: The high, low-pressure switch, anti-freeze protection, low voltage or heating high limit must trip three times within

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two hours before the unit control board will lock out the associated compressor. An alarm message will be displayed on the LCD screen.

j. Lead-Lag: Provide integrated, selectable Lead-Lag option allows equal run time hours on all compressors, thereby extending the life of all compressors.

k. Low Limit Control (LLC): Provide programmable low limit controls to prevent the supply air from dropping below a specified set point when there is a demand for cooling during cold outside conditions.

l. FDD (Fault Detection and Diagnostics): Constantly monitor refrigerant circuit pressures, refrigerant circuit temperatures and environmental temperatures and humidity via multiple sensor inputs.

1) Provide operational characteristics of the rooftop unit entire refrigerant circuit to ensure the unit is functioning at its specified performance level.
2) Provide alarms if the unit is not functioning optimally.
3) Remotely accessible via the Mobile Access Portal (MAP) gateway as well as scrolled on the UCB LCD screen

2.7 VARIABLE FREQUENCY DRIVE

a. Variable Frequency Drive shall be installed inside the unit cabinet, mounted, wired and tested.
b. Shall contain Electromagnetic Interference (EMI) frequency protection.
c. Insulated Gate Bi- Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform.
d. Built in LED display and controls. Does not require additional kit or options.
e. RS485 capability standard.
f. Electronic thermal overload protection.
g. 5% swinging chokes for harmonic reduction and improved power factor.
h. All printed circuit boards shall be conformal coated.

B. ACCESSORIES- FACTORY INSTALLED

1. Phase Monitor: Provide phase monitor to provide protection against phase reversal, phase loss, and phase unbalance conditions: (RTU-1 thru 3)
2. Power exhaust: Factory installed, powered by unit single point power connection: (RTU-1 thru 3)
3. Low leak economizer, comparative enthalpy: (RTU-1 thru 3)
4. Disconnects, non-fused, unit mounted: (RTU-1 thru 3)
5. Clogged filter and fan failure switches: (RTU-1 thru 3)
6. Hinged access doors: (RTU-1 thru 3)
7. Stainless steel drain pan: (RTU-1 thru 3)
8. Dehumidification, hot gas reheat: (RTU-1 thru 3)
9. Direct drive, plenum type, supply fan with VFD: (RTU-1 thru 3)
10. Duct mounted humidity sensor: (RTU-1 thru 3)
11. Powered Convenience outlet: (RTU-1 thru 3)
12. Clogged filter switch: (RTU-1 thru 3)

C. CAPACITIES AND CHARACTERISTICS

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1. Refer to schedule on drawings.

D. ELECTRICAL

1. General Requirements for Electrical:

   a. The air handling unit manufacturer shall factory prewire the fan motors, internal lights and switch, receptacles, where specified, The entire air handling unit as assembled at the factory shall be either UL or ETL labeled.
   b. Type THHN/THWN insulation, rated 600volts.
   c. All wiring shall be in accordance with NEC and the entire unit shall be either ETL or UL Certified.

2. Unit shall utilize factory Through-the-base Electrical with Disconnect Switch.
3. The unit shall have single power connection for 3 phase wiring with factory installed distribution blocks. All wiring shall terminate at a junction box for single point power hit. If a single point power hit is not provided between modular sections, contractor to provide all wiring between junction boxes to make a complete and operable system.
4. The unit shall have unit mounted, non-fusible, NEMA 4X, lockable disconnect switch.
5. The control voltage wiring shall be class 2, 120Vac and/or 24VAC/DC
6. The air handling unit manufacturer shall factory prewire an industrial quality vapor tight marine light fixture in the fan section and with an external switch near the access door and shall prewire a 120V ground fault circuit interrupting convenience receptacle inside the fan section.

2.8 ROOF CURBS

A. Delegated Design: Design roof curbs and associated anchors including comprehensive engineering analysis signed and sealed by a qualified professional engineer, licensed in the project location state, responsible for their preparation. Wind pressures are to be determined by delegated design engineer based on site specific wind criteria indicated below. All building attachments to be coordinated with existing structural conditions.

1. Detail fabrication and assembly of rooftop unit and roof curb.
2. Wind Design Loads:

   a. Basic wind speed: 105 MPH
   b. Exposure Category: C

B. Structural Performance: Equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

C. Materials: Design including all anchoring and fasteners for the Project site location. Construction shall be galvanized steel with corrosion-protection coating, watertight gaskets complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

   a. Materials: ASTM C 1071, Type I or II.
   b. Thickness: 2 inches.

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c. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

1) Liner Adhesive: Comply with ASTM C 916, Type I.
2) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

D. Curb Height: 24 inches.

2.9 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. All factory-built exhaust units shall be tested in accordance with the latest applicable industry standards as specified herein and be either UL or ETL listed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install unit on roof curb. Install wind restraints according to curb manufacturer's written instructions

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

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C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters

D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

E. Provide insulation within roof curb and insulate duct through the roof. Refer to drawing details for further information.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect duct to unit with a hard duct connection.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Install duct continuously through roof structure

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, section assembly, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Leak Test: If factory test of unit did not meet leakage rate requirements, unit to be retested in the field after final installation with all sections assembled and sealed to meet required leakage rates.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

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4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

D. Remove and replace malfunctioning units and retest as specified above

E. Prepare test and inspection reports.

3.5 START-UP SERVICE

A. Engage a factory-authorized service representative to perform start-up service.

1. Complete installation and start-up checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that dampers open and close.
7. Install new, clean filters.
8. Verify unit assembly is per manufacturer guidelines.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

D. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

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3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing the unit and air-distribution systems and after completing start-up service, clean units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 2-hours to adjust, operate, and maintain air-handling units.

END OF SECTION 237413

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SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.
3. Firestopping
4. Electrical Testing
5. Requirements which apply to all Electrical Work

B. The requirements indicated in this specification section shall apply to all Electrical Work (including, but not limited to, all work performed under Division 26, 27, and 28 if required under the scope of this project)

1.3 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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1.4 REFERENCES AND DEFINITIONS

A. Basic References: The following codes, standards, and approvals as referenced throughout the drawings and specifications, shall serve as the minimum standards and quality requirements directly appropriate to the work and workmanship. References to catalogs, standards, codes, specifications and recommendations, etc., means latest edition of such publications in effect at the date of invitation to submit bid.

1. American National Standards Institute (ANSI): ANSI C2; National Electrical Safety Code
2. National Electric Manufacturer's Association (NEMA) Standards as apply to specified Products.
3. National Fire Protection Association (NFPA):
   a. NFPA 70 (National Electrical Code)
   b. NFPA 72 (National Fire Alarm Code)
   c. NFPA 70E (Standard for Electrical Safety Requirements for Employee Workplaces), and other applicable NFPA codes
4. Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals shall govern the quality and performance of specified Products.
5. Americans with Disabilities Act (ADA)
6. Institute of Electrical and Electronics Engineers, Inc (IEEE)
7. National Electrical Contractor’s Association (NECA)
8. International Electrical Testing Association (NETA)
9. Occupational Safety and Health Administration (OSHA)

B. Definitions:

1. “Provide” - means “furnish and install”
2. “Indicated” - means “indicated in contract documents”
3. “Concealed” - means items referred to are hidden from normal sight, this includes items partly excavated or crawl spaces and in service tunnels used solely for repairs and maintenance
4. “Exposed” - means items are not “concealed”
5. “Feeder” - means “All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device”
6. “Feeder circuit breakers” - means circuit breakers protecting feeders.
7. NETA ATS- International Electrical Testing Association Acceptance Testing Specifications, Latest Edition
8. “Building” – A structure that stands alone or that is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors
9. “degrees C” – means “degrees Celsius”
10. “degrees F” – means “degrees Fahrenheit”
11. “homerun” – This word shall refer to that portion of the electrical circuit wiring and conduit between the circuit breaker or fuse protecting the electrical circuit, and the first equipment or load on the electric circuit. There is no other equipment or load on the electrical circuit between the first equipment or load, and the circuit breaker or fuse. For example, a 120V, 20A circuit breaker feeds #12 AWG wiring which connects to 3 – NEMA 5-20R receptacles. The wiring and conduit that runs from the circuit breaker to the 1st receptacle is considered the homerun wiring and conduit. There is no other receptacle on the electrical circuit between the 1st receptacle and the circuit breaker.

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12. "Branch circuit" – means "The circuit conductors between the final overcurrent device protecting the circuit and the outlets(s)."
13. "Suspended ceiling" – Suspended ceiling (sometimes referred to as dropped ceiling or false ceiling) is a secondary ceiling suspended or supported from the building structure above, creating a void between the underside of the building structure and the top of the suspended ceiling. Suspended ceilings include, but are not limited to, grid type ceilings, gypsum board ceilings, drywall type ceilings, and other ceilings which are located below the building structure. Suspended ceilings are either accessible ceilings (including, but not limited to, grid type ceilings with removable ceiling panels or tiles) or non-accessible ceilings (including, but not limited to, gypsum board ceilings and drywall type ceilings).
14. "Equipment" shall include, but not be limited to, fittings, devices, appliances, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation.
15. "Smoke duct detector" and "duct smoke detector" shall have the same meaning. Both terms shall mean smoke detectors which are used to detect smoke in HVAC (Heating, Ventilation, and Air Conditioning) ducts.
16. "Breaker" – means "circuit breaker"

1.5 BASIS OF DESIGN

A. The contract documents are prepared on basis of one manufacturer as "design equipment," even though other manufacturers' names are listed as acceptable makes. If Contractor elects to use one of the listed makes other than "design equipment," submit detailed drawings, indicating proposed installation of equipment. Show maintenance clearances, service removal space required, and other pertinent revisions to the design arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger electrical feeders, circuit breakers, equipment, additional control devices and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of rough-in and connections by other trades. Remove and replace door frames, access doors, walls ceilings or floors required to install other than design make equipment. If revised arrangement submittal is rejected, revise and resubmit specified "design equipment" item which conforms to contract documents.

1.6 INTENT OF DRAWINGS

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included. Drawings show approximate locations of equipment, fixtures, panelboards, conduits, and wiring devices. Exact locations are subject to the approval of the Owner's Representative. The general run of electrical feeders, branch circuits, and conduits, indicated on the drawings, is not intended to be the exact routing. Circuit designations, in the form of "Home Runs" on branches, indicate the designation of the branch circuit, the size and the quantity of branch circuit conductors, and the panelboard or interconnection box from which the branch circuit is served.

1.7 COORDINATION DRAWINGS

A. Where the contract documents require coordination drawings; or, where the contractor has any question or request-for-information that relates to locations of equipment, or coordination of equipment locations, the contractor shall provide a coordination drawing. The coordination drawing shall have reflected ceiling plans, structural plans, floor plans and other relevant drawings, drawn to scale on one drawing, on which the following items are shown and

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coordinated with each other, based on actual dimensions of the items, input from actual installer of the items involved, and existing conditions (the contractor shall field measure all existing conditions).

1.8 AS-BUILT DRAWINGS

A. The contractor shall provide "as-built" drawings, in both electronic and hardcopy formats. The contractor shall provide accurate project record drawings, showing in red color on the working drawings and electrical drawings, all changes, modifications, and alterations from the original drawings, made during installation of the work. Upon completion of the work, the contractor shall provide the Owner with a USB drive that has an electronic copy of the project record drawings, and a full size hardcopy of the project record drawings.

1.9 OPERATING AND MAINTENANCE MANUALS

A. General: Upon completion of the work, the Contractor shall furnish Operating and Maintenance Manuals for use by the Owner. The manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules and drawings describing location, operation, maintenance, lubrication, operating weight and other information necessary for the Owner to establish an effective operating and maintenance program.

B. Shop Drawings: Copies of appropriate shop drawings shall be included in the Operating and Maintenance Manuals. The requirements for manuals is a separate contractual item and in no way supersedes the requirements for shop drawings and vice-versa.

C. Approval: Completed manuals shall be submitted to the Engineer for review and approval. Incomplete or inadequate manuals will be returned to the Contractor for correction and resubmission.

D. Provide an electronic copy (PDF format) on 3 USB drives, and 3 hardcopies in 3-ring binders, of all operating and maintenance manuals, unless a greater quantity is specified elsewhere in the contract documents, in which case the greater quantity shall apply. Each drive and each hardcopy shall have all the operating and maintenance manuals for all the equipment.

E. Equipment keys and passwords shall be provided to the Owner's authorized representative or representatives. A document shall be provided indicating who received the keys and what are the passwords. Document shall be neat and typewritten.

F. Provide a separate section in the O&M Manuals for maintenance testing schedules of all equipment. A factory authorized representative of the equipment manufacturer shall certify the maintenance program. Include calendar schedule in table format to indicate all maintenance actions included during the warranty period with spaces for future testing.

G. All factory and field test reports by the contractor, manufacturer, and/or independent testing company shall be included in the O&M Manuals.

H. Wiring diagrams for all factory and field wiring shall be included in the O&M Manuals.

I. A complete list of spare parts and accessories for equipment shall be provided.

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1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to the Project site in a clean condition with openings plugged or capped (or otherwise sealed by packaging) both during shipping and during temporary storage.

B. Delivered electrical equipment crating and/or packaging shall clearly identify pick-points or lift-points. In the absence of crating or packaging, pick-points or lift-points must be identified on the equipment.

C. When unloading materials and equipment provide special lifting harness or apparatus as may be required by manufacturers. Handle materials and equipment in accordance with manufacturer's written instructions.

D. The Contractor shall determine the required equipment needed for unloading operations and have such equipment on site to perform unloading work on the date of equipment delivery.

E. Store materials and equipment, both on and off site, in accordance with manufacturer's written instructions. Keep equipment in a dry location.

1. Temporary Heating: Apply temporary heat to materials and equipment, according to manufacturer's written instructions, throughout periods when environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

1.11 WARRANTY

A. The Contractor shall guarantee that all work performed, and all materials/equipment installed by him, are free from defects. The Contractor shall repair or replace any defective equipment, materials or workmanship, free of cost to the Owner, for a period of two (2) years from the date of final acceptance of the Contractor’s work. The date of final acceptance is determined by the Owner. Where requirements indicated elsewhere in the contract documents (including, but not limited to, individual specification sections) indicate a Warranty period longer than two (2) years, the longer warranty period shall apply.

B. During this warranty period the Contractor shall:

1. Correct and make good all electrical defects. Faulty equipment and materials shall be repaired or replaced as required to produce satisfactory results as directed by the engineer and without additional cost to the Owner. Contractor shall provide service within 24 hours after the call has been made by the Owner.

1.12 DAMAGE TO OTHER WORK

A. Damage: Cutting or damage to existing structures, surfaces or installations shall be repaired at the expense of the Contractor. All such repairs or patching shall be neatly done by mechanics of the appropriate trade, and shall be done in such a fashion as to leave no readily apparent joint or change in appearance, and to leave no structural or other weakness.

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1.13 CONTRACTOR'S CERTIFICATION

A. The Contractor shall submit a signed and dated letter to the owner and the engineer certifying the following:

1. Electrical Contractor shall certify that all work has been performed in accordance with the contract documents (including, but not limited to: any amendments, addendums, and contract modifications) ;
2. Electrical Contractor shall certify that all work has been inspected and approved by the Authorities Having Jurisdiction; AND,
3. Electrical Contractor shall certify that all work has been performed in accordance with the National Electrical Code and all applicable codes.

1.14 TRAINING

A. Provide training for all equipment. Schedule training with at least 21 days advance notice, to the owner and engineer, by submitting a draft training schedule. Indicate all proposed training dates with specific equipment descriptions. The Contractor shall then confirm these dates with the owner and engineer. After receiving approval of these dates, the Contractor shall submit a final training schedule at least 14 days prior to the agreed upon dates.

B. All training shall be done hands-on, on-site, and in-person, on the actual equipment installed in the field.

C. The training instructor shall be factory trained by the manufacturer of the equipment. The qualifications of the training instructor shall be submitted for review/approval.

D. An attendance sheet shall be provided by the contractor during the training days. The attendance sheet shall be signed by all participants of the training, and the training instructor. The attendance sheet shall be submitted for record.

E. Provide a minimum of 8 hours of training for each equipment. Where individual specification sections indicate a training period longer than 8 hours, the longer training period shall apply.

F. Provide a video recording of all demonstration and training. The demonstration and training video shall be saved onto portable external hard drives. 3 sets of portable external hard drives shall be provided to the owner.

G. Training shall be provided for all equipment, whether or not training is mentioned in each individual specification section.

1.15 BUY AMERICA ACT COMPLIANCE LETTER

A. All equipment provided in the project shall comply with the Buy America Act. In addition to requirements stated elsewhere in the contract documents, the manufacturer of each equipment shall provide a signed/dated letter which states that all products/equipment being provided by him, comply with the Buy America Act. Please note that requirements stated elsewhere in the contract documents, may require that the manufacturer provides other submittals in addition to the letter required by this specification section. The manufacturer shall provide the submittals

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required by this specification section, and the submittals required elsewhere in the contract documents.

1.16 ABSENCE OF SPECIFICATION

A. Where the drawings or the specifications do not name a particular brand or manufacturer of any item, these items are still part of the Work. This Contractor shall provide all such items that may be fairly and reasonably judged throughout the construction industry to be the most appropriate and best quality item for the intended application. Provide submittals for proposed items to the Architect for review and approval.

1.17 DISCREPANCY IN DRAWINGS AND/OR SPECIFICATIONS

A. Where the drawings and/or the specifications pose a conflict in design intent requirements, quality of work, or equipment the contractor must submit an RFI for clarification during the bid process in compliance with the front end specifications to provide resolution or provide the greater of the conflicting equipment or workmanship after the submission of bid, or cutoff date for RFI's

PART 2 - PRODUCTS – *Not Used*

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Workmanship: Workmanship shall be of the highest grade and all installation work shall be performed by thoroughly qualified mechanics of the appropriate trade. All equipment shall be installed and connected in accordance with the best engineering practice. Manufacturer's instructions and recommendations shall be followed and all electric connections shall be provided.

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G. Completeness: The Contractor shall furnish and install all labor, materials, tools, equipment, programming, software, startup, licenses, and services as required to make all equipment complete and fully operational. Provide all required mounting hangers, supports, hardware and accessories to install all equipment and devices. Make all equipment and devices complete and fully operational.

H. Drawings: The drawings showing the layout of the electrical system indicate approximate locations of outlets, apparatus and equipment. The runs of feeders and branches as shown, the drawings are schematic only and are not intended to show the exact routing and location of conduits and conduit terminations. The final determination as to routing, location and termination shall be governed by structural conditions, obstructions and job conditions. This shall not be construed to mean that the design of the system may be changed without the written approval of the Engineer; it merely refers to the exact run of raceways and the exact placement of outlets, etc. It shall be the Contractor's responsibility to obtain all shop drawings affecting conduit terminations to the equipment specified in this or other sections or furnished by others, and to verify conduit locations before installation. The Contractor shall consult all contract drawings and specifications which may affect the location of any outlet, equipment or conduit run, to avoid improper locations of such items and to avoid interference with other trades.

I. Accessibility: Electrical equipment such as junction and pull boxes, panelboards, switches, controls, and other apparatus that may require maintenance or operation from time to time, shall be made easily accessible. Although the equipment may be shown on the drawings in certain locations, in the course of building construction, it may develop that such locations do not afford proper accessibility, in which case the Contractor shall direct the Engineer's attention to the condition before advancing the construction.

J. Site examinations: All bidders, prior to submitting a bid, shall thoroughly acquaint themselves with the conditions under which the work will be performed. No allowance shall be made subsequently in connection with this, for any error or negligence on the contractor’s part.

K. Unless noted as “EXISTING”, “BY OTHERS” or “NIC”, all work, devices and equipment are new and shall be furnished and installed by the contractor.

L. The contractor shall comply with all the requirements indicated in the contract documents. The contractor shall provide all the items indicated in the contract documents, without any additional cost or time extension, regardless of whether or not the item is a special order, the item is in short supply, the item has a minimum quantity order requirement, the item has a long lead time, and/or the item has additional/non-standard costs associated with it. The contractor shall coordinate with the manufacturer and supplier of the item prior to submitting a bid.

M. Furnish and install devices and equipment in accordance with the NEC, the manufacturer’s recommendations, and the contract documents.

N. All devices and equipment shall be suitable for its intended use, environment, and location in accordance with the NEC, UL, the manufacturer’s recommendations and the contract documents.

O. All work shall be coordinated with the General, and all other trades Contractors.

P. Wire lugs, connectors and splices shall be UL Listed and shall be compatible with the wire size/material/type. Coordinate equipment and wiring to ensure that they are compatible with each other.

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Q. Do not exceed the maximum wire pulling tension recommended by the wire manufacturer. Coordinate with the wire manufacturer as required. Pull wire through handholes, manholes, and other underground structures in a manner that shall minimize the pulling tension on the wire.

R. Prior to installing the equipment, the contractor shall field survey and verify the exact locations where the equipment are being installed, and shall notify the engineer immediately if there are any issues or conflicts. Also, prior to installing the equipment, the contractor shall coordinate the exact location of the equipment with the engineer, whether or not there are any issues or conflicts. Prior to installing the equipment, the contractor shall adjust the exact locations of the equipment, in accordance with the direction provided by the engineer

S. Mounting heights indicated in the Contract Documents are measured from the finished floor or finished grade to the bottom of the equipment, unless otherwise noted.

T. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

U. Provide touch up paint as required on equipment finishes that have been scratched, and provide touch up paint as directed by the Engineer. Touch up paint shall be provided in accordance with the manufacturer's recommendations. Do not allow paint to come in contact with conductors, insulation or any live parts. All nameplates and labels shall remain visible and legible.

V. Where there are space heating equipment located adjacent to electrical equipment (including but not limited to, infrared unit heaters, electric/gas fired unit heaters, etc), the contractor shall coordinate with the manufacturer of the space heating equipment, get the installation manuals for the space heating equipment, and determine the clearance requirements around the space heating equipment. The contractor shall comply with the clearance requirements of the manufacturer, and shall not install any electrical equipment/wiring/conduit within the clearance area. Additionally, all electrical equipment/wiring/conduit shall be provided with appropriate clearance from space heating equipment, so that their maximum operating temperature, and/or temperature rating, is not exceeded.

W. Inside rooms which can be entered by vehicles (including, but not limited to, vehicle maintenance and storage rooms), keep the space directly in front of the exterior door (overhead door, rollup door, swing door, etc.) clear of all electrical items. The volume of the clear space shall not be less than the following:

1. Volume of clear space = width of the exterior door opening x height of the exterior door opening x distance from the exterior door to the opposite wall

X. Where the contract documents specifies a product name, model, or manufacturer, and this product has been discontinued or is no longer in production, the contractor shall provide a product from the same manufacturer, that meets the requirements indicated in the contract documents, at no additional cost to the owner. The product provided by the contractor shall be an approved equal of the specified product. Also, the contractor shall provide a written statement from the specified manufacturer, indicating that the specified product has been discontinued or is no longer in production. All products shall be submitted for review and approval by the design team.

Y. The contractor shall core drill holes in exiting concrete walls, ceilings, and floors as required for the installation of wiring and conduit. The contractor shall use ground penetrating radar to scan

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the concrete for any obstructions and/or structural elements/components prior to core drilling. Core drilling shall be made only at locations which are free of obstructions and/or structural elements/components. Do not drill, cut, or damage beams, joists, trusses, and other load bearing structures. All work shall be reviewed and approved by the owner, the architect, the structural engineer, and the Authorities Having Jurisdiction.

Z. Where equipment and systems require registration for any purpose (including, but not limited to, registration for the purposes of enrollment in warranty plans, service plans, software update plans, etc.), the contractor shall register the equipment and systems as required, and provide all account/login information/passwords to the owner.

AA. The contractor shall apply and pay for all permits related to his work. All work shall be inspected and approved by the Authorities Having Jurisdiction.

BB. All work shall comply with the NEC and the applicable codes.

CC. Provide access doors where the NEC or the manufacturer requires access for equipment concealed behind walls or ceilings. Access doors are specified in Section 083113 “Access Doors And Frames”. Provide fire rated access doors for fire rated walls and ceilings.

DD. All free standing electrical distribution equipment, unless otherwise indicated, shall be provided on concrete equipment bases minimum of four inches above finished floor or grade and extending a minimum of 6” past the equipment footprint.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials must be approved for specific use.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.

C. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

D. Manufacturers:

2. 3m
3. Rockwool
4. Tremco
5. STI

E. Comply with the applicable requirements indicated in Section 078413 "Penetration Firestopping", or the requirements in this specification section, whichever is more stringent.

3.3 TESTING REQUIREMENTS AND INSTRUCTIONS

A. The Electrical Contractor shall provide supervision, labor, materials, tools, test instruments and all other equipment or services and expenses required to test, adjust, set, calibrate, and operationally check work and components of the electrical system and circuitry throughout the work.

B. The Electrical Subcontractor shall pay for all tests specified in this Section, including expenses incident to retests occasioned by defects and failures of equipment to meet specifications, at no additional cost to owner. Any defects or deficiencies discovered in any of the electrical work shall be corrected.

C. The Electrical Contractor shall:

1. Replace wiring and equipment found defective (defined as failing to meet specified requirements) at no additional cost to Owner
2. Submit digital copies of test results to the Engineer.

D. Do not void equipment warranties or guarantees by testing and checkout work. Checks and tests shall be supplemental to and compatible with the manufacturer's installation instructions. Where deviations are apparent, obtain the manufacturer's approved review of procedure prior to testing. Where any repairs, modifications, adjustments, tests or checks are to be made, the Contractor shall contact the engineer to determine if the work should be performed by or with the manufacturer’s representative.

1. All checks and tests specified for proper operating and safety of equipment and personnel are to be performed concurrent with progression of the w work, prior to Final Acceptance by owner.

E. Tests are to:

1. Provide initial equipment/system acceptance.
2. Provide recorded data for future routine maintenance and trouble shooting.
3. Provide assurance that each system component is installed satisfactorily and can be expected to perform, and continue to perform, its specified function with reasonable reliability throughout the life of the facility.

F. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, or faulty, is to be reported to the engineer. Corrective action by the Contractor requires prior engineer approval, retesting, and inspection.

G. Prior to testing and start-up, equipment and wiring shall be properly and permanently identified with nameplates, and other identification as specified in this Section. Check and tighten terminals and connection points, remove shipping blocks and thoroughly clean equipment, repair damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for delivery to the engineer. Make routine checks and tests as the job progresses to ensure that wiring and equipment is properly installed.

H. Testing and checkout work is to be performed with fully qualified personnel skilled in the particular tests being conducted. Personnel are to have at least five years of experience with tests of same type and size as specified.

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I. Inspections and tests shall be in accordance with the following applicable codes and standards as amended to date, unless otherwise specified.

1. National Electrical Manufacturer's Association - NEMA.
2. American Society for Testing and Materials - ASTM.
3. Institute of Electrical and Electronic Engineers -IEEE.
4. National Electrical Testing Association - NETA.
5. American National Standards Institute - ANSI.

    a. C2: National Electrical Safety Code.
    b. Z244-1: American National Standard for Personnel Protection.

6. Insulated Cable Engineers Association - ICEA.
7. Association of Edison Illuminating Companies - AEIC.
8. Occupational Safety and health Administration.

    a. OSHA Part 1910; Subpart S, 1910.308.
    b. OSHA Part 1926; Subpart V, 1926.950 through 1926.960.

9. National Fire Protection Association - NFPA.

    a. 70B: Electrical Equipment Maintenance.
    b. 70E: Electrical Safety Requirements for Employer Workplaces.
    c. 70: National Electrical Code.
    d. 78: Lightning Protection Code.
    e. 101: Life Safety Code.

10. Inspections and tests shall utilize the following references:

    a. Contract Drawings and Specifications.

11. Contractor's Short Circuit and Coordination Study.
12. Manufacturer's printed test procedures for respective equipment.

J. Test Equipment:

1. Test equipment used by the Contractor is to be inspected and calibrated.
2. Perform calibration and setting checks with calibrated test instruments of at least twice that of that of the accuracy of the equipment, device, relay or meter under test. Dated calibration labels shall be visible on test equipment. Calibrations over 6 months old are not acceptable on field test instruments. Inspect test instruments for proper operation prior to proceeding with the tests. Record serial and model numbers of the instruments used on the test forms.

K. Test Procedures:

1. The Electrical Subcontractor is responsible for the preparation of the procedures and schedules for the work specified herein. This work is to be coordinated and compatible with both the work and schedule of the other crafts. Sequence the tests and checks so that the equipment can be energized immediately after the completion of the application tests.
2. Submit proposed testing and check out forms. The procedures shall provide specific instructions for the checking and testing of each electrical component of each system.

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Schedule tests and inspections as the job progresses. Test procedures submitted shall include job safety rules.

L. After each electrical system installation is complete, perform the tests to determine that the entire system is in proper working order and in accordance with applicable codes, manufacturer's instructions, drawings, and specifications. Tests are in addition to shop tests of individual items at the manufacturer's plant. Perform insulation and ground resistance tests before operating tests.

M. Perform insulation tests on electrical equipment, apparatus, cables, motors, generators, transformers, circuit breakers and switches, switchgear, motor control centers, and similar electrical equipment, at the following times and conditions:

1. Prior to energization and/or placing into service.
2. When damage to the insulation is suspected or known to exist.
3. After repairs or modifications to the equipment affecting the insulation.
4. Where lightning or other surge conditions are known to have existed on the circuit.

N. Make openings in circuits for test instruments and place and connect instruments, equipment, and devices, required for the tests. Upon completion of tests, remove instruments and instrument connections and restore circuits to permanent condition.

O. List each circuit and measured resistance as test data. Maintain record of insulation resistance values. Identify conductor, or equipment, date that value was taken and resistance value. Arrange information in tabular form and submit to Engineer.

P. Report inspections, tests, and calibrations in writing on engineer-approved reports/forms. The recorded data form shall have the signatures of the persons conducting the tests, authorized witnesses, and the engineer. The forms shall serve as the test and inspection checklist.

Q. When the electrical tests and inspections specified or required within this Section are completed and results reported, reviewed, and approved by the engineer, the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor will then affix appropriate, approved, and dated completion or calibration labels to the tested equipment and notify the engineer of electrical completion. If the engineer finds completed work unacceptable, he will notify the Contractor in writing of the unfinished or deficient work, with the reason for his rejection, to be corrected by the Contractor. The Contractor will notify the engineer in writing when exceptions have been corrected. The Contractor will prepare a "Notification of Substantial Electrical Completion" for approval by the engineer following engineer's acceptance of electrical completion. If later in-service operation or further testing identifies problems attributable to the Contractor, these will be corrected by the Contractor, at no additional cost to owner.

R. Specific Tests:

1. Perform the following specific tests. De-energize and isolate equipment and cable prior to performing the tests.
2. Wire and Cable: (All conductors originating from main switchboard and distribution panels).

a. Before energizing any cable or wire, megger the insulation resistance of every external circuit wire to each other and to ground. Tests shall be conducted at

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voltages of 500 volts or lower. Continuity test each wire and cable to verify the field applied tag per conductor. Minimum insulation resistance valves shall not be less than two megohms.

b. Take insulation resistance measurements for motor feeders. With motors disconnected, measure insulation resistance from load side of contactors or circuit breakers.

c. Check cables and wires for the proper identification numbering and/or color coding.

d. Inspect cables for physical damage and proper connection in accordance with single line diagram.

3. Power Distribution System:

a. Circuit Breakers

1) Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.
2) Operate circuit breaker to ensure smooth operation.
3) Inspect case for cracks or other defects.
4) Check tightness of connections with calibrated torque wrench. Refer to manufacturer's instruction for proper torque levels.
5) Perform a contact resistance test or measure millivolt drop at rated current.
6) Perform an insulation resistance test at 1000 volts dc for one (1) minute from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase - 500V D.C. if circuit breaker is solid state.
7) Adjustable trip breakers shall have minimum pickup current determined by primary current injection where applicable.
8) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Determine trip time.
9) Determine short time pickup and delay by primary current injection if applicable to the particular breaker.
10) Determine ground fault pickup and time delay by primary current injection if applicable to the particular breaker.
11) Determine instantaneous pickup current by primary injection using run-up or pulse method. Clearing times shall be within four (4) cycles.
12) Verify trip unit reset characteristics.
13) Perform adjustments for final settings in accordance with breaker setting sheet if applicable to the particular breaker.
14) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
15) Insulation resistance shall not be less than 100 megohms.
16) Trip characteristic of adjustable trip breakers shall fall within manufacturer's published time-current characteristic tolerance band.
17) All circuit breakers mounted in switchboards and distribution boards shall be time-current tested by primary current injection where possible, and also any remotely mounted breakers of frame size 400 ampere and larger.
18) Adjust settings and calibrate all circuit breakers as recommended in the short circuit analysis and coordination study.

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b. Panelboards

1) Inspect for physical damage and proper grounding.
2) Compare nameplate information with schedules and report any discrepancies.
3) Inspect all panelboards for cleanliness, workmanship, etc.

c. Operating Instructions: Furnish operating instructions to User Agency's designated representative with respect to operations, functions and maintenance procedures for equipment and systems installed. Cost of such instruction up to a full five (5) days of Electrical Subcontractor's time shall be included in contract. Cost of providing a manufacturer's representative at site for instructional purposes shall also be included.

3.4 THIRD PARTY ELECTRICAL INSPECTION

A. Contractor shall hire a third-party inspection agency to inspect electrical work.

B. Contractor shall carry in their bid all required expenses.

END OF SECTION 260500

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Conductors rated up to 1000V.
3. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

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

B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Service Wire Company

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2. Encore Wire.
3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation:

1. THHN/THWN-2 Wire:

a. Complies with NEMA WC 70
b. Listed to UL 83
c. Suitable for operation at 600 volts or less in wet or dry locations.
d. 90 degree C rated in wet or dry locations.

2. XHHW-2 Wire:

a. Complies with NEMA WC 70
b. Listed to UL 44
c. Suitable for operation at 600 volts or less in wet or dry locations
d. 90 degree C rated in wet or dry locations.
e. Insulation is an abrasion, moisture, and heat resistant cross-linked polyethylene (XLPE)
f. Wire sizes which are #8 AWG and larger shall be gas/oil resistant, and sunlight (UV) resistant.

3. RHH/RHW-2 Wire:

a. Complies with NEMA WC 70
b. Listed to UL 44
c. Suitable for operation at 1000Volts or less in wet or dry locations
d. 90 degree C rated in wet or dry locations.

D. Two-hour Fire Rated: Comply with UL2196 Type RHW

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Submersible Connectors and Splices: Submersible connectors and splices shall have all of the following features:

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1. UL listed as a sealed wire-connector system
2. UL 486D Listed for direct burial and submersible applications

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Service Entrance: Copper. Stranded.

B. Feeders: Copper. Stranded.

C. Branch Circuits:

1. Solid for No. 10 AWG and smaller, unless otherwise noted and except as follows:

a. Where the conductors connect to vibrating equipment (including, but not limited to, transformers, motors, and generators), the conductors shall be stranded.
b. Where the equipment manufacturer recommends stranded conductors, the associated conductors shall be stranded.

2. Stranded for No. 8 AWG and larger.

D. DC Power to interface devices (plug-in dispensers or pantographs): Copper. Stranded. 1000V rated

E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway. Even if only a small portion of the feeder is concealed in concrete, below slab-on-grade, or underground, the entire length of the feeder shall be XHHW-2 from end-to-end.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway, unless otherwise noted and except as follows:

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1. MC (Metal Clad) cable may be used in lieu of THHN/THWN-2, single conductors in raceway, where allowed by Section 260533 “Raceways and Boxes for Electrical Systems”.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway. Even if only a small portion of the branch circuit is concealed in concrete, below slab-on-grade, or underground, the entire length of the branch circuit shall be XHHW-2 from end-to-end.

H. Wiring on the load side of Variable Frequency Drives: Type XHHW-2 single conductors in raceway, unless otherwise noted.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

J. Wiring for DC power connections between charger and dispensers: Type RHH/RHW-2 single conductors in metallic raceways, unless otherwise noted.

K. Fire Rated Cable: 2-hour fire rated Type RHW, unless otherwise noted

1. Use cable where the drawings indicate that fire rated cable is required.
2. Increase size of the conduit from what is indicated in the drawings, as required in order to accommodate the larger size of the fire rated cable. Comply with the NEC and the manufacturer’s recommendations.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Where wires larger than #12 AWG are installed on 15A or 20A branch circuits, splice #12AWG “pigtails” for connections to circuit breakers, devices and equipment. “Pigtails” in this paragraph shall mean short leads used to connect a circuit breaker, device or equipment to branch circuit wires. Comply with all of the following:

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1. Length of the wires of the “pigtails” shall be less than 48”, unless otherwise noted and except as follows:

    a. At light poles, the length of the “pigtails” shall be increased to match the height of the light pole such that the “pigtail” splice is located in the handhole at the base of the pole. The length of the “pigtail” shall not exceed 125% of the overall height of the light pole.

2. Where the “pigtails” are run inside raceways, the length of the raceways shall be less than 23”, and the raceways shall be sized per NEC requirements.
3. Provide junction boxes as required for splicing wires.
4. The wire size of the phase, neutral, and ground wires of the “pigtails” shall not be less than #12AWG.
5. All work shall comply with NEC, the manufacturer’s recommendations, and the contract documents.

H. Do not combine separate branch circuits in the same raceway, unless otherwise noted and except as follows:

1. Branch circuits may be combined in the same raceway where ALL of the following conditions are met:

    a. The branch circuits being combined in the same raceway serve the same area or adjacent areas.
    b. The branch circuits being combined in the same raceway homerun to the same panelboard.
    c. The number of branch circuits being combined in the same raceway does not exceed 3.
    d. The number of current carrying conductors installed in the same raceway does not exceed 6.
    e. The branch circuits are installed in a manner that does not subject them to any ampacity derating, except for the ampacity derating caused by having 4 to 6 current carrying conductors in the same raceway.
    f. The branch circuits that are being combined in the same raceway are all fed from 1-pole circuit breakers that have a trip rating of either 15 amperes or 20 amperes.
    g. The branch circuits that are being combined in the same raceway are not fed from circuit breakers that have a trip rating greater than 20 amperes.
    h. The branch circuits that are being combined in the same raceway are limited to 1-phase circuits that have a voltage of either 120V or 277V.
    i. The smallest wire size, in the branch circuits which are being combined in the same raceway, is not smaller than #12 AWG.
    j. The wires that are combined in the same raceway do not exceed the NEC wire fill capacity of the raceway. The raceway size is increased as required to comply with NEC requirements.
    k. The branch circuits which are being combined in the same raceway are limited to lighting and receptacle branch circuits.
    l. Dedicated neutral wires are provided for all branch circuits.
    m. Ground wires are provided in accordance with NEC requirements. Grounding and bonding are provided in accordance with NEC requirements.
    n. Where the NEC does not allow branch circuits to be combined in the same raceway, the branch circuits are not combined in the same raceway.

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o. All work complies with the NEC, the manufacturer's recommendations, and the contract documents.

I. Underground splices of service, feeder, and branch circuits shall not be permitted, unless otherwise noted.

1. Where the drawings specifically indicate that underground wires shall be spliced, submersible splices and connectors shall be used. The contractor shall mark the locations of the underground splices on the as-built drawings.

J. Conductor terminations at all charging equipment and components shall be performed as recommended by the equipment manufacturer. Provide crimp narrow cable lugs of maximum allowable width per manufacturer recommendations.

3.4 CONNECTIONS

A. 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.

B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm).

3.5 FIRESTOPPING

A. Refer to Section 260500 "Common Work Results for Electrical".

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

a. Electrical tests (this includes, but is not limited to: insulation resistance testing) are required on all wiring that is #2 AWG and larger, and all sizes of underground wiring. Visual and mechanical inspections are required on all wiring.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.

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3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

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1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors and Cables:

a. Refer to Division 26 Section “Conductors and Cables”

2. Grounding Rods:

a. Harger
b. Blackburn
c. nVent Erico Inc.

3. Mechanical Connectors:

a. Burndy (a Hubbell Company)
b. Harger

4. Exothermic Connections:

a. nVent Erico Inc

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

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5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

H. Conduit Hubs: Mechanical type, terminal with threaded hub.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one or two-piece clamp.

O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

P. Water Pipe Clamps:

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1. Mechanical type, two pieces with stainless-steel bolts.

    a. Material: Die-cast zinc alloy.
    b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

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F. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

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B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 FENCE GROUNDING

A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:

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1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.

    a. Gates and Other Fence Openings: Ground fence on each side of opening.

        1) Bond metal gates to gate posts.

        2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.7 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

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D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install **tinned** bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.

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2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

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4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **10** ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5** ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **3** ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: **1** ohm(s).
5. Substations and Pad-Mounted Equipment: **5** ohms.
6. Manhole Grounds: **10** ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Metal framing systems with conduit attachment.
2. Hanger rods and connections.

C. Welding certificates.

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1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design trapeze conduit hangers and equipment supports.

B. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. Thomas & Betts Corporation.
e. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

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C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. To Existing Concrete: Expansion anchor fasteners.

4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RGS: Rigid steel conduit.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

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4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alflex Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. O-Z Gedney; a unit of General Signal.
4. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed. Coordinate first subparagraph below with Drawings.

1. Fittings for EMT: Compression type.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Erickson Electrical Equipment Company.
2. Hoffman.
3. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
4. O-Z/Gedney; a unit of General Signal.
5. RACO; a Hubbell Company.
6. Robroy Industries, Inc.; Enclosure Division.

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7. Spring City Electrical Manufacturing Company.
8. Thomas & Betts Corporation.

B. Sheet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: RGS, Use EMT in Office Areas.
2. Exposed, Not Subject to Severe Physical Damage: RGS, Use EMT in Office Areas.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

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5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Final Connection to Charging Equipment: LFMC, maximum of 6ft.
7. Damp or Wet Locations: Rigid steel conduit.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. EMT Conduit: Use compression, raintight fittings, unless otherwise indicated.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from ENT to rigid steel conduit, or EMT before rising above the floor.

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I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

K. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials must be approved for specific use.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.

C. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for conductors.
2. Equipment identification labels.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

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PART 2 - PRODUCTS

2.1 CONDUCTOR MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch (10 mm).

B. Contractor shall provide information labels on all receptacles, panelboards, junction boxes, wall switches & disconnect switches. Labels shall be phenolic type with black background & white engraved lettering. Label shall indicate circuit/feeder source & equipment ID name.

PART 3 - EXECUTION

3.1 APPLICATION

A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

B. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Engraved, laminated acrylic or melamine label.

2. Equipment to Be Labeled:

   a. Panelboards, electrical cabinets, and enclosures.
   b. Transformers.
   c. Disconnect switches.
   d. Push-button stations.
   e. BEB chargers and associated dispenser
   f. Remote emergency shutdowns

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3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White
   e. Ground: Green

2. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: White
   e. Ground: Green

3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553

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SECTION 260923 - LIGHTING CONTROL DEVICES

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. Photoelectric switches.
2. Standalone daylight-harvesting switching and dimming controls.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy Sensors.
b. Vacancy Sensors.
c. Daylight Harvesting Sensors

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

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1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wattstopper.
2. System Sensor
3. Hubbell

2.2 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

A. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.

1. Lighting control set point is based on the following two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

B. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with integrated OR separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

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D. Power Pack: Digital controller capable of accepting four RJ45 inputs with two output(s) rated for 16-A of LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.

1. With integral current monitoring.
2. Compatible with digital addressable lighting interface.
3. Plenum rated.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated or Separate power pack.
4. Hardwired or Wireless connection to switch BAS and lighting control system.

5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Power: Line voltage.
8. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
9. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

10. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
11. Bypass Switch: Override the "on" function in case of sensor failure.
12. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

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B. Dual-Technology Type: Wall or Ceiling mounted (where indicated on floor plans); detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection or wireless connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24].
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V.
5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
6. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

8. Color: White.
9. Faceplate: Color matched to switch.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch .

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

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E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

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3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

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SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

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D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Finishes:

a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.

3. Ground Lugs and Bus-Configured Terminators: Compression type.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

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2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker as shown on the plans.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 NEMA PB 1.1.

B. Mount top of trim 90 inches above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

E. Install filler plates in unused spaces.

F. Comply with NECA 1.

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3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Twist-locking receptacles.
5. Pendant cord-connector devices.
6. Cord and plug sets.
7. Decorator-style devices, 20 A.
8. Occupancy sensors.
9. Digital timer light switches.
10. Wall plates.
11. Floor service fittings.
12. Poke-through assemblies.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

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1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Service-Outlet Assemblies: One for every 10 but no fewer than one.
2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

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E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: Unless otherwise indicated or required by NFPA 70 or device listing provide wiring device color as follows:

a. Administrative area which includes offices, breakrooms, conference rooms and similar – White with white matching coverplates.
b. Maintenance bays, support areas such as electrical and mechanical rooms, bus storage and service lane, and similar spaces – gray with stainless steel cover plates.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
2. Leviton Mfg. Company Inc. (Leviton).
3. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

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4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.

4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.

4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 USB RECEPTACLES

A. USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.
4. Combination USB type A and USB type C ports.

2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Feed or non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

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2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Feed or Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Feed or Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.6 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L5-20R.
2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L6-20R.
2. Standards: Comply with UL 498.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.

C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

E. Standards: Comply with FS W-C-596.

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2.8 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Single-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20.

B. Decorator Single-Pole Lighted Switches,120/277 V, 20 A:

1. Description: Square face illuminated when circuit is switched off.
2. Standards: Comply with UL 20.

2.10 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch-thick,
3. Material for Unfinished Spaces: satin-finished, Type 302 stainless steel, spaces shall include maintenance bays, vehicle storage

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum or thermoplastic with lockable cover. Shall be designed and manufactured to remain weatherproof while receptacle is plugged in.

2.11 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings:

1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
2. Compartments: Barrier separates power from voice and data communication cabling.
3. Service Plate and Cover: die-cast aluminum with satin finish.
4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

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5. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

2.12 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

B. Standards: Comply with scrub water exclusion requirements in UL 514.

C. Service-Outlet Assembly: type with two simplex receptacles and space for two RJ-45 jacks, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

D. Size: Selected to fit nominal cored holes in floor and matched to floor thickness.

E. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

F. Closure Plug: Arranged to close unused openings and reestablish fire rating of floor.

G. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

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2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

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3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light emitting diode

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Driver.

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4. Energy-efficiency data.

5. Life, output, and energy-efficiency data for LEDs.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with drivers or LEDs and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Luminaire installation instructions.

C. Product Certificates: For each type of driver for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Qualification Data: For agencies providing photometric data for lighting fixtures.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

B. Provide support structures as required for various fixture installation locations such as under ductwork or other work that prevents fixture mounting to building structure.

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.

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1. LED Fixtures: 1 for each type

1.8 WARRANTY

A. Special Warranty for LED luminaires: Manufacturer's standard form in which the luminaire manufacturer agrees to repair or replace any failed components, material, or workmanship within specified warranty period.

1. Warranty period for LED luminaires: Five (5) years minimum from the date of substantial completion.

1.9 DELIVERY, STORAGE, AND HANDLING

1. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Luminaire Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Recessed Fixtures: Comply with NEMA LE 4.

C. Lamp base complying with ANSI C81.61.

D. CRI of minimum 80. CCT of 3000 K.

E. Nominal Operating Voltage: 120 V ac.

2.3 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

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C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.4 LED SYSTEMS

A. The LED array module or LED board and all its components shall be subject to mechanical stress.

B. Assembly shall not be put together in such a way as to damage or destroy conducting paths of the LED circuit board.

C. Installation of LED modules and all its components that are required for operation, including power supplies shall comply with all applicable electrical safety standards.

D. Electrical polarity shall be clearly identified, or the connectors shall be designed in a way that polarity can’t be reversed when the modules are electrically plugged in.

E. LED modules shall be installed in specifically designed housing or be tested in a housing that has the proper thermal heat sinking properties to support LED array installation.

F. LED circuit board shall be protected by a coating against moisture and dust. The coating shall be factory applied,

G. The LED array module shall be operated with an electronically stabilized power supply offering protection from short circuits, overload, and overheating.

2.5 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

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B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and maintenance.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

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2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

D. Prepare test and inspection reports.

END OF SECTION 265100

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SECTION 265600 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections:

1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LED: Light emitting diode.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. Pole: Luminaire support structure, including tower used for large area illumination.

H. Standard: Same definition as "Pole" above.

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1.4 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
6. Retain one of first two subparagraphs below. Retain "Testing Agency Certified Data" Subparagraph if photometric data for one or more luminaires are based on independent laboratory tests; coordinate with the Exterior Lighting Device Schedule on Drawings to indicate which units are required to meet this requirement. Retain "Manufacturer Certified Data" Subparagraph if photometric data based on testing by accredited manufacturers' laboratories are considered adequate for all exterior luminaires in this Project. See Evaluations.
7. Photoelectric relays.
8. Ballasts, including energy-efficiency data.
9. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
10. Materials, dimensions, and finishes of poles.
11. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
12. Anchor bolts for poles.

13. Manufactured pole foundations.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

4. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

1.5 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.

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1. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

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B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected from manufacturer's standard catalog of colors.

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b. Color: Match Architect's sample of [manufacturer's standard] [custom] color.
c. Color: As selected by Architect from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LED FIXTURES

A. Requirements for LED Fixtures

1. Minimal Characteristics

a. CRI: 80
b. Lamp Life: 100,000 hrs
c. Correlated Color Temperature: 4000K, unless otherwise indicated on the Luminaire Schedule.

2. LED fixtures, lamps, and drivers shall meet the following standards.

a. IES LM-79-2008, Approved Method for the Electrical and Photometric Testing of Solid-State Lighting Devices
b. IES LM-80-2008, Approved Method for Measuring Lumen Depreciation of LED Light Sources
c. IES TM-21-2011, Projecting Long Term Lumen Maintenance of LED Light Sources
d. NEMA SSL 1-2010, Electronic Drivers for LED Devices, Arrays, or Systems

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e. NEMA SSL 4-2012, Retrofit Lamps: Minimum Performance Requirements
f. NEMA SSL 6-2010, Solid State Lighting for Incandescent Replacement—Dimming
g. ANSI/NEMA/ANSLG C78.377. Specifications for the Chromaticity of Solid State Lighting Products

3. Outdoor applications: Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
4. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires

2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

2.6 ALUMINUM POLES

A. Source Limitations: Obtain poles from single manufacturer or producer compatible with the luminaire.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

1. Shape: Tapered, flutted, decorative.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

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3. Provide with decorative flared base cover.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches with cover secured by stainless-steel captive screws.

G. Vibration Dampers: Provide factory installed or field installed integral vibration dampers. Dampers shall be integral or concealed on the interior of the pole. First mode and/or second mode dampers shall be provided as recommended by the manufacturer for the application.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

I. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.

2.7 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

B. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
3. Match pole material and finish.

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C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Vibration Dampers: Provide factory installed or field installed integral vibration dampers. Dampers shall be integral or concealed on the interior of the pole. First mode and/or second mode dampers shall be provided as recommended by the manufacturer for the application.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

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3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top at grade.

3.5 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

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1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600

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SECTION 28 3111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

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

B. Examine all other Sections of the Specifications for requirements that affect work under this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 SUMMARY

A. Section Includes:

1. Fire alarm systems with manual stations, detectors, signal equipment, controls, notification devices, booster panels, and other related devices.
2. Connection to door hardware for door closers/holders, electric door locks, and release existing devices that interface with fire alarm systems.
3. Monitoring connections to fire pump controller and emergency generator.
4. Contractor shall provide and install microprocessor based fire alarm and detection system devices in accordance with NFPA 72. Installation shall include all parts, labor, software, and hardware necessary to effect a complete installation.

B. Section Includes:

1. Fire-alarm control unit.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Remote annunciator.
6. Addressable interface device.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only

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1.5 SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FCI; a Honeywell Company
2. EST
3. NOTIFIER; a Honeywell Company.
4. Siemens Building Technologies, Inc.; Fire Safety Division.
5. Simplex; a Johnson Controls Company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations
2. Heat detectors.

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3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
4. Record events in the system memory.
5. Record events by the system printer.

C. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

D. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

   a. Smoke sensors shall additionally communicate sensitivity setting.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

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1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

   a. Initiating Device Circuits: Pathway Survivability Level 1.
   b. Notification Appliance Circuits: Pathway Survivability Level 1.
   c. Signaling Line Circuits: Pathway Survivability Level 1.
   d. Install no more than 50 addressable devices on each signaling line circuit.

2. Serial Interfaces: Two RS-232 ports for printers.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

2.4 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be hardwired-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
   c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

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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. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric 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. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

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2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

   a. 110 cd for weatherproof devices
   b. Field selectable 15/30/75/110 cd

2. Mounting: Wall mounted unless otherwise indicated.
3. Flashing shall be in a temporal pattern, synchronized with other units.
4. Strobe Leads: Factory connected to screw terminals.
5. Mounting Faceplate: Factory finished, red.

2.7 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.8 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm

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receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

D. Verification that both telephone lines are available.

E. Programming device.

F. LED display.

G. Manual test report function and manual transmission clear indication.

H. Communications failure with the central station or fire-alarm control unit.

I. Digital data transmission shall include the following:

J. Address of the alarm-initiating device.

K. Address of the supervisory signal.

L. Address or loss of power.

M. Low battery.

N. Abnormal test signal.

O. Communication bus failure.

P. Secondary Power: Integral rechargeable battery and automatic charger.

Q. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.

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5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

J. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Electronically locked doors and access gates.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt-trip breaker.
7. Data communication circuits for connection to building management system.
8. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
9. Supervisory connections at fire-pump engine control panel.
10. Supervisory connection to emergency generators.

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3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

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F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **12** months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.7 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for **two** years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

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SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

A This section specifies site preparation which consists of clearing, grubbing and demolition. See Section 02 41 10, Selective Structure Demolition, for related work.

B Existing Conditions:

1. Review and determine the actual condition of the site as it affects the Work.

C Protection:

1. Site preparation shall not damage structures, landscaping or vegetation outside of the limits of construction as noted on the drawings. Any property damaged shall be repaired or replaced.
2. Site preparation shall not be performed within areas indicated on the drawings as protected.
3. Provide documentation of existing conditions in accordance with Section 01 32 33, Photographic Documentation
4. Repair, or replace improvements damaged or removed by clearing and grubbing. Repair and replacement shall be to equal or better condition as determined by the Owner's Representative .

D Work Limits

1. Do not enter, clear or perform work on adjacent property or Rights-of-Way (ROW) not covered by the permit(s), right-of-entry agreements, temporary construction easements, or permenant easements.
2. Stake boundaries, permitted work limits, and clearing limits prior to commencing Work.
   a. Stake clearing limits at each property boundary and easement boundary crossing.
   b. Provide temporary fencing at easement boundaries/clearing limits as required to maintain public safety, security and control of erosion and sediment.
   c. Provide temporary and permenant erosion and sediment control as required.

E Schedule:

1. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 2 acres.

F Permits

G Definitons:

1. INTERFERING OR OBJECTIONABLE MATERIAL: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying.
2. CLEARING: Removal of interfering or objectionable material lying on or protruding above ground surface.
3. GRUBBING: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6-inches below subgrade.
4. WORK LIMITS: Areas, as shown or specified, within which Work is to be performed.
5. SCALPING: Removal of surface material such as roots, sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter. The depth of scalping does not include topsoil or other material below the scalping operation.

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6. STRIPPING: Removal of topsoil remaining after applicable scalping is completed.
7. TOP SOIL: Topsoil is that uppermost layer of soil capable of growing and supporting vegetation, containing essential microorganisms, nutrients, organic matter, and physical characteristics necessary to grow and sustain permanent vegetation.

1.2 RELATED SECTIONS

A This section contains specific references to the following related sections.
1. Section 01 32 33 Photographic Documentation

1.3 QUALITY ASSURANCE

A References
1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B Quality Assurance
1. Obtain Owner's Representative approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.4 SUBMITTALS

A Procedures: Section 01 33 00, Submittal Procedures.

B Action Submittals
1. A copy of this entire specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owner's Representative shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Submit working drawings clearly showing limits of clearing, grubbing, and stripping.
   a. Show obstructions to be removed and replaced.
   b. Show separation between areas to be cleared and areas not to be cleared.
   c. Provide show drawings, materials of fencing, barriers to be provided.

1.5 HEALTH AND SAFETY

A Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 GENERAL LIMITS

A As follows, but not to extend beyond Work limits.
1. Excavation, excluding trenches, 5 feet beyond top of cut slopes.

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2. Fill:
    a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
    b. Stripping and Scalping: 3 feet beyond toe of permanent fill.
3. Structures: 20 feet outside of structures.
4. Vehicular Entrances/drives and Pavement:
    a. Clearing, grubbing, scalping, and stripping 15 feet from pavement shoulders.
5. Perimeter Fence:
6. Clearing, grubbing, scalping, and stripping 4 feet on both sides

2.2 GREEN FIELD/BROWN FIELD SITES

A Salvage top soil for reuse. Clear, grub, and remove, and dispose of trees, stumps, and debris.

B This work shall be performed at the beginning of the project so that the parcel may be used as a staging area. See Section 01 12 16, Work Restrictions And Sequence.

2.3 TREE REMOVAL AND PRUNING

A Remove dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.

B Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

C Remove branches below the following heights:
1. 13.5 feet above roadways and shoulders.
2. 9 feet above sidewalks.
3. 6 feet above roofs.

PART 3 - EXECUTION

3.1 GENERAL

A Unless otherwise specified, the Contractor shall remove obstructions such as brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.

B Limit clearing and grubbing to the areas required to complete the Work.
1. Verify that existing trees and plant life designated to remain. Tag, identify or fence such areas to ensure compliance.
2. Locate, identify, and protect utilities to remain in place from damage.

C Provide Erosion and Sediment Control measures in accordance with the Contractor's accepted SWPPP.

D Protect benchmarks, survey monuments, survey control points and other improvements to remain in place from damage or displacement.
1. Land monuments, property markers, or official datum points
    a. Protect from damage and displacement.
    b. If removal is required to complete the work, provide reference for re-establishment before removing. Work shall be in accordance with the Newton County survey requirements including all recording requirements with the Newton County register.

E Protect trees and other vegetation from damage to roots and branches if they are designated to remain.
1. Provide tree protection where specified.

3.2 **CLEARING, GRUBBING AND STRIPPING**

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A Remove brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.

B Remove trees as specified:

1. Fell trees so that they fall away from facilities, and vegetation not designated for removal. Protected trees within the Work limits must be designated and fenced prior to the start of construction.

C Strip, disk or otherwise remove all heavy soils, heavy growths of grass, and sod that comprise the organic root-zone. The depth of stripping will generally be four (4) to six (6) inches but will vary across the site.

D Stripped organic material and topsoil shall be stockpiled at accepted locations.

1. Separate differing materials with dividers or stockpile apart to prevent intermixing of soil types or contamination. Excavated topsoil shall be removed and stored separately for other excavated materials.
2. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
3. Prior to restoring the site, process stockpiled material through a 3” screen and place screened material as topsoil.

E Fill depressions caused by clearing and grubbing operations with select native backfill or topsoil material unless further excavation or earthwork is indicated. Place material in uniform layers not exceeding a loose depth of 8” and compact each layer to a density equal to the adjacent ground.

F Coordinate with Owner's Representative for additional areas that require clearing to accommodate construction activities.

3.3 DEMOLITION

A Demolition shall meet the requirements of Section 02 41 10, Selective Structure Demolition.

3.4 OBSTRUCTIONS

A Remove obstructions that do not require replacement from within the work limits including but not limited to tree roots, stumps, abandoned piling, buildings and concrete structures, frozen material, logs, and debris of all types without additional compensation.

B Remove and replace fences, fence post, signs, and all other improvements removed, damaged or disturbed during completion of the Work.

1. Replacement shall be to a condition equal to or better than prior to construction unless specifically identified for removal in the demolition plan.

3.5 UTILITY INTERFERENCE

A Where existing utilities interfere with the execution of the work, the Contractor shall relocate them in accordance with the General Conditions of the Contract Documents.

3.6 DISPOSAL

A Remove excess materials and materials from the site as cleared and as Work progresses.

1. Do not allow materials to accumulate on-site.
2. Debris may not be relocated on the site unless otherwise specified.
3. Open burning and burial in trenches or embankments is prohibited.

B Dispose of materials off the site in accordance with local, state, federal and agency requirements.

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END OF SECTION

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SECTION 31 23 00
EXCAVATION AND FILL - A

PIPPART 1 GENERAL

1.1 DESCRIPTION

A Scope:

1. This section specifies earthwork which consists of excavation, filling, grading, and disposal of excess material.

B Definitions:

1. Compaction: The degree of compaction is specified as percent compaction. Maximum or relative densities refer to dry soil densities obtainable at optimum moisture content.
2. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.
3. Embankment Slope: Embankment slope shall be defined as an inclined surface formed by placement of material above existing grade.

1.2 QUALITY ASSURANCE

A References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, referesandnces to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	**Title**
ASTMC136	Standard Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in. (457-mm) Drop
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3017	Test Method for Moisture Content of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)

B Tests:

1. TheConstruction Manager will take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance

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with these specifica tions. The Contractor shall remove surface material at locations designated by the Construction Manager and provide such assistance as necessary for sampling and testing. The Construction Manager may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the has complied with these specifications. Payment for inspection trenches shall be as specified in the General Conditions of the Contract Documents .

2. Tests will be made by the Construction Manager in accordance with the following:

Test	Standard Procedure
Moisture content	ASTM D3017
Gradation	ASTMC136
Density in-place	ASTMD1556
Moisture-density relationships	ASTM D1557

1.3 SUBMITTALS

A Samples of fill materials to be used shall be submitted 2 weeks in advance of use. Samples shall consist of 0.5 cubic feet of each type of material.

1.4 REFERENCE STANDARDS

A ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

B ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A Type A:

1. Type A material shall be a clean gravel-sand mixture free from organic matter and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3/4 inch	100
3/8 inch	70-100
No. 4	55-100
No. 10	35-95
No. 20	20-80
No. 40	0-55
No. 100	0-2

B Type B:

1. Type B material shall be a select granular material free from organic matter and of such size and gradation that the specified compaction can be readily attained. Material shall have a sand equivalent value determined in accordance with ASTM D2419 of not less than 20 and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3 inch	100
No. 4	35-100
No. 30	20-100

2. The coefficient of uniformity shall be 3 or greater.

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3. The material may be an imported quarry waste, clean natural sand or gravel, select trench excavation or a mixture thereof.

C Type C:

1. Type C material shall be unclassified material which is free from peat, wood, roots, bark, debris, garbage, rubbish or other extraneous material. The maximum size of stone shall not exceed 6 inches. If the material excavated from the site meets these requirements, it may be classified as Type C.

D Type F:

1. Type F material shall be crushed rock and shall conform to the following gradation:

U.S. standard sieve size	**Percent by weight passing**
1-1/2 inch	87-100
3/4 inch	45-90
No. 4	20-50
No. 30	6-29
No. 200	0-12

2. Type F material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

PART 3 EXECUTION

3.1 GENERAL

A Control of Water:

1. The Contractor shall keep excavations reasonably free from water during construction. The static water level shall be drawn down a minimum of 1 foot below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Disposal of water shall not damage property or create a public nuisance. The Contractor shall have on hand pumping equipment and machinery in good working condition for emergencies and shall have workmen available for its operation. Dewatering systems shall operate continuously until backfill has been completed to 1 foot above the normal static groundwater level.
2. Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. The Contractor shall control surface runoff to prevent entry or collection of water in excavations.
3. Release of groundwater to its static level shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines.

B Overexcavation:

1. Where the undisturbed condition of natural soils is inadequate for support of the planned construction, the Construction Manager will direct the Contractor to overexcavate to adequate supporting soils. The excavated space shall be filled to the specified elevation with backfill. The overexcavated space under footings may be filled with concrete. The quantity and placement of such material will be paid for as extra work.

C Surplus Material:

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1. Unless otherwise specified, surplus excavated material shall be disposed of off site in accordance with applicable ordinances and environmental requirements.
2. If the quantity of surplus material is specified, the quantity specified is approximate. The Contractor shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any material inside or outside the site. Shortage of material, caused by premature disposal of any material by the Contractor, shall be replaced by the Contractor.
3. Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure except for those areas designated to be preconsolidated. For these areas, the depth of stockpiled material shall be as specified. The Contractor shall maintain stability of the soil adjacent to any excavation.

D Borrow Material:

1. If the quantity of acceptable material from excavation is not sufficient to construct the embankments required by the work, the quantity of material needed to complete the embankments shall consist of imported borrow conforming to specified requirements.

E Hauling:

1. When hauling is done over highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.

F Haul Roads:

1. The Contractor shall construct haul roads required to transport materials on site. Alignment of haul roads shall be selected to avoid interference with plant operations. Haul roads shall be removed after completion of embankment construction.

G Finish Grading:

1. Finished surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
2. Finished grade shall be as specified by the contours plus or minus 0.10 foot except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage. Allowance for topsoil and grass cover, and subbase and pavement thickness shall be made so that the specified thickness of topsoil can be applied to attain the finished grade.
3. When the work is an intermediate stage of completion, the lines and grades shall be as specified plus or minus 0.5 foot to provide adequate drainage.
4. If the soil is to be cultivated or straw is to be incorporated into the surface, rocks larger than 2-1/2 inches in maximum dimension, roots and other debris on the surface of the slope shall be removed and disposed of prior to cultivation or placement of straw.

H Control Of Erosion:

1. The Contractor shall maintain earthwork surfaces true and smooth and protected from erosion. Where erosion occurs, theContractor shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

3.2 CLASSIFICATION OF FILL

A Fill material shall be placed in horizontal layers and compacted with power-operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative

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compaction, and general application are specified in Table A. Unless otherwise specified, fill classes shall be used where specified in Table A under general application.

Table A, Fill Classifications

Fill class	Material type	Maximum uncompressed layer depth, inches	Minimum relative compaction, percent	General application
A1	A	8	95	Bedding for pipe, initial pipeline backfill; slabs on grade (other than specified for Class E1)
B1	B	8	95	Structure and subsequent pipeline backfill
B2	B	8	90	Site fill
C1	C	8	90-95	Subsequent pipeline backfill; compaction as specified
F1[b]	F	12	95	Structure backfill, pipeline bedding, initial and subsequent pipeline backfill

a. Compaction of layers shall be accomplished in two passes of equipment with complete coverage across the width of the field.
b. Material shall not be used for bedding or initial backfill for plastic pipe.
c. Fill material shall be grouted as specified in paragraph 3.08.
d. Asphalt and concrete slabs from demolition may be placed at the bottom of the fill side by side to form a continuous pad. Clearing and grubbing is not required unless shrubs are taller than 3 feet. Mucking of the subgrade and keying or benching of adjoining embankments is not required.

3.3 EARTHWORK FOR STRUCTURES

A Structure Excavation:

1. The bottom shall not be more than 0.15 foot above or below the lines and grades specified. If the elevation of structure excavation is not specified, the excavation shall be not more than 0.15 foot above or below the elevation specified for fill material below the structure. Slopes shall vary no more than 0.5 foot from specified grade unless the excavation is in rock where the maximum variation shall be 2 feet.
2. Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the Contractor's operations and require overexcavation and backfill, the Contractor shall refill such excavated space to the proper elevation in accordance with the procedure specified for backfill. The cost of such work shall be borne by the Contractor.
3. Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

B Foundation Treatment:

1. Rock foundations for concrete or masonry footings shall be excavated to sound material. The rock shall be roughly leveled or cut to steps and shall be roughened. Seams in the

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rock shall be grouted under pressure as directed by the Construction Manager and paid for as extra work.

2. When footings are to be supported on piles, excavations shall be completed to the bottom of the footings before any piles are drilled or driven therein. When swell or subsidence results from driving piles, the Contractor shall excavate, or backfill the footing area to the grade of the bottom of the footing with suitable material as specified. If material under footings is such that it would mix into the concrete during footing placement or would not support the weight of the fluid concrete, the Contractor shall replace the material with suitable material, install soffit forms or otherwise provide a suitable platform on which to cast the footing as directed by the Construction Manager. This shall be paid for as extra work.
3. Whenever any structure excavation is substantially completed to grade, the Contractor shall notify the Construction Manager who will make an inspection of the foundation. No concrete or masonry shall be placed until the foundation has been inspected by the Construction Manager. The Contractor shall, if directed by the Construction Manager, dig test pits and make test borings and foundation bearing tests. If the material tested is undisturbed soil, the cost thereof will be paid for as extra work. If the material tested is backfill material, the cost thereof will be paid as specified in the General Conditions of the Contract Documents.

C Structure Backfill:

1. Unless otherwise specified, structure backfill shall be Class B1.
2. After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.
3. Structure backfill shall not be placed until the subgrade portions of the structure have been inspected by the Construction Manager. No backfill material shall be deposited against concrete structures until the concrete has developed a strength of not less than 2500 pounds per square inch in compression, or until the concrete has been in place for 28 days, whichever occurs first.
4. Backfill material shall be placed in uniform layers and shall be brought up uniformly on all sides of the structure.
5. Unless otherwise specified, backfill around and above pipelines within the excavation line of any structure shall be the same as that specified for structures.

3.4 EARTHWORK FOR PIPELINES AND CONDUITS

A General:

1. Earthwork for pipelines and conduits is specified in Table A; in the standard details; and in the following paragraphs.

B Pipeline Excavation:

1. The bottom of the trench shall be carried to the specified lines and grades with proper allowance for pipe thickness and for bedding as specified.

C Utility Installation:

1. Refer to NCWSA Standards, Article 5 for trenching, bedding, and backfill of water/sewer piping.

D Storm Piping Installation:

1. Pipeline Backfill:

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a. Bedding: The Contractor shall not proceed with backfill placement in excavated areas until the subgrade has been inspected by the Construction Manager. All pipe shall have a minimum thickness of bedding material below the barrel of the pipe as specified. Bedding material shall be placed in the bottom of the trench, leveled and compacted. Bell holes shall be excavated at each pipe joint to permit proper inspection and uniform bearing of pipe on bedding material.
    1) After the pipe has been laid to alignment and grade, unless otherwise specified, additional bedding material shall be placed in layers the full width of the trench and compacted up to the specified level. Bedding shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. The material shall be carefully placed and compacted around the pipe to ensure that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Contractor shall use particular care in placing material on the underside of the pipe to prevent lateral movement during backfilling.

b. Initial Backfill: After pipe has been properly bedded, Contractor shall place and compact initial backfill as specified. Initial backfill, where specified below the springline of the pipe, shall be placed and compacted in accordance with paragraph 3.04 Pipeline Backfill for additional bedding material.

c. Subsequent Backfill:
    1) General: Backfill material, placement and compac tion above the pipe zone shall be as specified. Backfill above the pipe zone shall not commence until pipe zone backfill has been inspected and accepted by the Construction Manager.
    2) Improved Areas: Unless otherwise specified, select granular backfill (Common Fill) shall be used under all paved and unpaved roadways and paved and unpaved roadway shoulders, roadway embankments, and in all public right-of-ways and easements. The trench shall be backfilled to an elevation which will permit the placement of the specified surface or paving. Paving shall be as specified in Section 32 12 16. Other surfaces shall be restored, including compaction, to the condition existing prior to construction including restoration of yard areas.
    3) Unimproved Areas: Class C1 backfill shall be used for all trenches in pastureland, cultivated land, undeveloped land, and for other unimproved areas where specified. Class C1 backfill shall not be used in any public right-of-way. Trench excavation which meets the requirements of Type C material may be used. The Contractor shall maximize the use of fine-grained materials (e.g., sand, silty sand, sandy silt) as Class C1 backfill.
        (a) For Class C1 backfill, the trench above the pipe zone shall be backfilled to within 12 inches of original ground surface. The top 12 inches of soil shall be removed and stored in such a manner that it will not become mixed with unsatisfactory soils. After the trench has been backfilled, the stored topsoil shall be replaced at a uniform depth in its original area compacted to its original condition. The Contractor shall leave the backfilled trench neatly

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mounded not more than 6 inches above existing grade for the full width of the Class C1 backfill area.

3.5 SUBGRADE FOR PAVEMENT

A The prepared subgrade shall be scarified to a depth of at least 12 inches and recompacted to at least 95 percent of the maximum density.

3.6 SITE FILL

A Unless otherwise specified, site fill shall be Class C2 fill. If the existing slope in an area to be filled is greater than 5:1, the Contractor shall bench the area prior to filling.

END OF SECTION

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SECTION 31 41 00
SHORING

PART 1 - GENERAL

1.1 DESCRIPTION

A Scope:

1. This section specifies requirements for sheeting, shoring, and bracing of trenches greater than 5 feet in depth or where required to protect adjacent property, improvements or grades. The Contractor shall provide all labor, equipment, materials, and services necessary.

B Design Requirements:

1. The Contractor shall design sheeting, shoring, and bracing in accordance with 29 CFR, Part 1926, Subpart P, Excavations of the Federal OSHA standards and the Georgia State Labor Code. The standards of design referred to in the Labor Code shall be those of the Federal OSHA standards.
2. Design excavation support systems to withstand earth pressures, hydrostatic pressures, bottom heave, equipment loads, applicable traffic and construction loads, and other surcharge loads to allow safe construction without movement or settlement of the ground and to prevent damage to or movement of adjacent structures, streets, and utilities. Design each member or support element with appropriate safety factors.
3. Acceptable excavation support methods include the use of trench boxes, suitable moving support systems, steel sheet pilings, soldier piles and lagging, jet grouted structures, secant pile structures, structural steel wales and struts, liner plates, and timber. If soldier piles are used, insert in predrilled holes. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
4. Provide construction stage loadings for a staged removal of the support system that conforms to the pipe, structure placement, and indicated backfill.
5. Compaction of foundation, bedding, haunching, and backfill shall extend to the undisturbed trench wall during staged removal of the support system.
6. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.

1.2 RELATED SECTIONS

A This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.

1. Newton County Water & Sewerage Authority, Standards & Specifications, March 2022

1.3 REFERENCES

A This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or

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otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
OSHA	OSHA Safety Regulations (29 CFR, Part 1926, Subpart P, Excavations)

1.4 SUBMITTALS

A Procedures: Section 01 33 00, SUBMITTAL PROCEDURES.

B Action Submittals:

1. A copy of this entire specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Submit design calculations, shop drawings, and detail drawings that demonstrate conformity with OSHA regulations and suitability for design loads and installation methodology.
   a. The design shall be stamped and signed by a Registered Professional Engineer of the State of _____.
3. Submit shop drawings showing dimensions, elevation, and structural details for each utilized excavation support system. Include on the drawings any required construction sequence, loading, testing, monitoring, and re-bracing/removal requirements. The design shall be stamped and signed by a Registered Professional Engineer of the State of _____.

PART 2 - PRODUCTS

2.1 TRAFFIC BEARING PLATES:

A To meet the DOT Specification.

B Steel plates to be milled into the asphalt so that they are flush with the existing surface. A written approval from Agency having Jurisdiction is required to install steel plates that are not flush with the existing surface.

PART 3 - EXECUTION

3.1 GENERAL

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A The construction of sheeting, shoring, and bracing shall not disturb the state of soil adjacent to the trench and below the excavation bottom.

B Trench sheeting below the top of a pipe shall be left in place.

3.2 SEQUENCE

A Trench excavation shall not be started until the design for trench support has been accepted by the Owner.

END OF SECTION

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

A This section specifies paving consisting of aggregate base, asphaltic concrete, and associated materials.

1.2 QUALITY ASSURANCE

A References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in (457-mm) Drop

B Testing:

1. Testing will be conducted by the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT to determine compliance with the specified degree of compaction and moisture content.

PART 2 - PRODUCTS

2.1 MATERIALS

A Aggregate Base:

1. Aggregate base shall be 8", 3/4-inch maximum grading conforming to GDOT Standard Specifications Construction of Transportation Systems - Section 300 — General Specifications for Base and Subbase Courses.

B Liquid Asphalt:

1. Liquid asphalt for tack coatsand treatment of aggregate base shall be Grade MC 250 and shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 413 - Bituminous Tack Coat. A prime coat shall be applied and shall comply with _____ . GDOT Standard Specifications Construction of Transportation Systems - Section 312 -Bituminous prime

C Asphalt Concrete:

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1. Aggregate shall conform to GDOT Standard Specifications Construction of Transportation Systems - Section 802 - Aggregates for Asphaltic Concrete. Asphalt binder shall be paving asphalt, Grade AR-4000, and shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 820 -Asphalt Cement. Asphalt concrete mixing and proportioning shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 820 -Asphalt Cement.

D Traffic Line Paint:

1. Traffic line paint shall be a white latex traffic paint 21209 by Glidden, Vin-L-Stripe acrylic epoxy traffic paint W-801 by Dunn-Edwards, or equal.

E Seal Coat:

1. The seal coat shall be slurry type with Grade SS1 asphaltic emulsion conforming to GDOT Standard Specifications Construction of Transportation Systems - Section 820 - Asphalt Cement .

PART 3 - EXECUTION

3.1 GENERAL

A Construction shall conform to the details, dimensions and grades specified. Maximum variations in finished grade of paving shall be plus or minus 0.05 feet.

3.2 AGGREGATE BASE PLACEMENT

A Subgrade:

1. Areas to be paved shall be graded and compacted in accordance with Section 31 23 00 Excavation and Fill .
2. Where specified, the subgrade shall be treated with lime in accordance with GDOT Standard Specifications Construction of Transportation Systems - Section 225 - Soil-Lime Construction utilizing 5 percent (dry weight) hydrated lime.

B Aggregate Base:

1. Placing of aggregate base shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 815 - Graded Aggregate. Relative compaction shall be a minimum of 95 percent as determined using methods set forth in ASTM D1557.

3.3 ASPHALT CONCRETE PAVEMENT

A Asphalt Concrete:

1. Placement of asphalt concrete pavement shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 400 - Hot Mix Asphaltic Concrete Construction. Berms shall be shaped and compacted with an extrusion machine.

B Tack Coat:

1. Tack coat shall be applied to all vertical surfaces of existing pavement; to curbs, gutters, and construction joints against which asphalt concrete will be placed; to pavements to be surfaced; and where specified at the approximate rate of 0.05 gallons per square yard. Application shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 413 - Bituminous Tack Coat. Immediately prior to placing asphalt concrete, additional tack coat shall be applied to areas where the tack coat has been damaged.
2. Immediately prior to construction of asphalt concrete berms, a continuous tack coat shall be applied to the pavement surface. Application of the tack coat shall not cause a slip or weakened plane between the two joined surfaces.

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C Traffic Line Painting:

1. Traffic lines shall be painted on pavement surfaces where specified. Surfaces are to be free of contaminants that may interfere with adhesion. Thinning and coverage shall be as recommended by the manufacturer, but coverage shall not exceed 400 square feet per gallon. Traffic lines shall be of uniform width with the edges straight and even. Traffic shall be restricted from the area until the paint has dried.

D Prime Coat:

1. Prime coat shall be applied to the aggregate base prior to placement of asphalt concrete pavement at the approximate rate of 0.25 gallons per square yard. Application shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 312 -Bituminous prime . Prior to placement of subsequent material, any excess primer which has failed to penetrate the surface shall be blotted with clean sand.

E Seal Coat:

1. Immediately prior to applying the seal coat, surfaces shall be cleaned of all dirt and loose materials. Following cleaning, surfaces shall be uniformly dampened with water at the approximate rate of 0.15 gallons per square yard. The seal coat shall be applied at the approximate rate of 0.12 gallons per square yard. Application shall comply with GDOT Standard Specifications Construction of Transportation Systems - Section 820 -Asphalt Cement.

END OF SECTION

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SECTION 32 13 13
CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SCOPE

A This work shall consist of furnishing and constructing a jointed Portland cement concrete pavement, concrete base course or concrete shoulder, with or without reinforcement, as shown on the plans or as directed by the Engineer. The work also includes curbs, curb and gutter, and integral curb and sidewalk. This work shall be done in accordance with 2026 Georgia Department of Transportation (GDOT) Standard Specifications for Construction, and as specified in the Standards of the County, City, or Township having jurisdictional authority, as well as the latest edition of Standard Specifications for Paving and Related Construction for Newton County, Department of Public Works. The types of concrete paving will be as classified in the current GDOT Standard Specifications for Construction.

1.2 GENERAL

A Governing Standards

1. AASHTO (American Association of State Highway and Transportation Officials) M33 as Revised – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
2. AASHTO M213 as Revised – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
3. AASHTO T26 as Revised – Standard Method of Test for Quality of Water to be Used in Concrete.
4. AASHTO T96 as Revised – Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
5. AASHTO T148 – Standard Method of Test for Measuring Length of Drilled Concrete Cores
6. ACI (American Concrete Institute) 301 – Specifications for Structural Concrete.
7. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete.
8. ASTM (American Society for Testing and Methods) A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
9. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
10. ASTM C31/C31M – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
11. ASTM C33 – Standard Specification for Concrete Aggregates.
12. ATM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C42/C42M – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
14. ASTM C94/C94M– Standard Specification for Ready-Mixed Concrete.
15. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
16. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic-Cement Concrete.
17. ASTM C150 – Standard Specification for Portland Cement.

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18. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
19. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
20. ASTM C174/C174M – Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
21. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
22. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
23. ASTM C309– Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
25. ASTM C595 – Standard Specification for Blended Hydraulic Cements.
26. ASTM C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
27. ASTM D98 – Standard Specification for Calcium Chloride.
28. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
29. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM E29 – Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.

1.3 REFERENCE STANDARDS

A ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

B ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

C ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

D ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.

E ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

F ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

G ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.4 QUALITY ASSURANCE

A Perform work in accordance with 2026 GDOT Standard Specifications for Construction and as specified in the standards of the County, City, and Township having jurisdiction as well as the Standard Specifications for Paving and Related Construction for Newton County, latest edition.

B Obtain cementitious materials from same source throughout.

C Testing

1. The Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT shall make cylinders for compressive strength tests as well as slump tests for consistency and tests for air content concurrently at the job site. These tests shall be made for all exposed concrete used in commercial driveways, building construction; concrete paving projects; repairs of

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public streets, sidewalks, curbs, and driveways; new curbs, sidewalks, and driveways; and/or at such locations deemed necessary by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT for quality control of concrete placed on public property.

2. A minimum of one test for slump and one test for air content shall be taken for each 25 cubic yards (19.1 cu m), or portion thereof, of concrete placed. Should test results so dictate, the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT may order additional testing to assure quality concrete. Tests for entrained air and slump of concrete may also be made by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT when concrete is being placed.
3. Air content tests shall be in accordance with ASTM C231 or ASTM C173. The concrete, when deposited in the forms for pavements or curbs, shall contain 6 percent (plus or minus 1 percent) of entrained air.
4. The consistency of concrete mixes will be determined by the slump cone test as specified in the method of test for slump of Portland Cement Concrete ASTM C143.
5. The consistency of the concrete shall not exceed the limits listed below:
   a. Concrete for street pavement including base course and curbs shall have a maximum slump of 3 inches (7.6 cm).
   b. Concrete for sidewalks and driveway paving shall have a maximum slump of 5 inches (12.7 cm).
   c. For any single batch, slump tests of individual samples taken at approximately the one-quarter and the three-quarter points of the load shall differ by not more than 1 inch (2.5 cm).
6. Compression test specimens shall be prepared in accordance with ASTM C31 with 1 set of 4 standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
7. Compressive-strength tests shall follow ASTM C39 with 1 set for each day's pour exceeding 5 cubic yards (3.82 cu m) plus additional sets for each 50 cubic yards (38.2 cu m) more than the first 25 cubic yards (19.1 cu m) of each concrete class placed in any 1 day. Test 1 specimen at 7 days, 2 specimens at 28 days, and hold 1 specimen in reserve for later testing if required.

1.5 SUBMITTALS

A The following submittals shall be provided in accordance with Section 01 33 23:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up

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specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B Mix Design

1. Submit certification that concrete mix conforms to specified MDOT mixes. Submit three copies of the mix design for approval for all non-MDOT concrete mixes.

C Product Data

1. Submit data on joint filler, admixtures, and curing compounds.

1.6 DELIVERY, STORAGE, AND HANDLING

A Concrete materials shall be so furnished, handled, and stored as to preclude inclusion of foreign matter and permit easy access for inspection. Storage facilities shall be sufficient and so stocked and maintained as to assure concrete placement at the required rate without damaging delays. Handling methods and storage facilities shall be subject to the approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.

B Cement shall be so handled and stored as to be protected from the weather, dampness, and contamination. Cement shall be used in the same relative order as received. Cement salvaged or reclaimed from cleaning sacks, leaking containers, or discarded sacks shall not be used. Any cement which, for any reason, has become partially set, contains lumps of caked cement, or is in any way contaminated shall be rejected and shall be promptly removed from the site.

C Aggregates shall be so furnished, handled, and stored as to insure uniformity of the specified grading at the time of batching, and that the moisture content will be reasonably constant for each day's run. Aggregate requiring pre-washing shall not be used until the surplus water has disappeared and the material has a uniform and acceptable water content.

D Fine and coarse aggregates, aggregates from different sources, and various classes of coarse aggregates shall be separately stored.

PART 2 - PRODUCTS

2.1 MATERIALS

A General

1. Concrete shall be composed of a mixture of Portland cement, fine aggregate, coarse aggregate, fly ash, admixtures when specified, and water. The materials and methods used shall produce a dense, homogenous impervious, durable, and workable concrete of the highest quality and without defects of any kind.
2. The materials shall meet the requirements specified in the MDOT Standard Specifications for Construction unless otherwise indicated on the drawings.
3. For instances where an MDOT mix is not specified, provide concrete as follows unless indicated otherwise on the Drawings: Grade "A" concrete shall be used throughout the work except that Grade "C" concrete may be used for backfills, unless stronger concrete is called for on the plans.
4. Grade "A" concrete shall have a minimum compressive strength of 4,000 psi (27,579 kPa) at 28 days and shall contain not less than 6 ½ sacks of cement per cubic yard (8 ½ sacks of cement per cubic meter) of concrete. Grade "C" concrete shall have not less than 3 sacks of cement per cubic yard (4 sacks of cement per cubic meter) of concrete.

B Water

1. Water used in concrete or mortar mixtures or for curing concrete shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Owner furnished potable water may be used without testing.
2. For water requiring testing, the tests will be conducted in accordance with AASHTO T26. Water from sources other than City tap water shall meet the following requirements:
   a. Total solid matter, max
      1) 0.03%
   b. Organic matter, max
      1) 0.05%
   c. Alkalinity – Acidity
      1) Natural to litmus
3. Water failing to meet these requirements may be approved for use if, when comparative tests are made between the proposed water and distilled water, using an approved cement, there is no indication of unsoundness, marked change in time of setting, or a reduction of more than 10 percent in mortar compressive strength.
4. The water intake shall provide for the exclusion of silt, mud, grass, or other foreign materials.

C Cement

1. Cement for pavement, base course, curbs, sidewalk, and shoulder, as called for on Plans or as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT shall be “Portland Cement” conforming to the respective requirements of the applicable ASTM specifications listed below. Cement of only one kind and type shall be used throughout the work and it shall be a standard brand of a single producer, unless otherwise specifically authorized by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
   a. Portland Cement Types I, IA, III, and IIIA shall conform to ASTM C150. The requirements for Gillmore Setting Time Test and compressive strength through the 28 day test shall apply.
   b. Portland Cement Types IS and IS-A Blast-Furnace Slag shall conform to ASTM C595.

D Fine Aggregate (Sand)

1. Fine aggregate shall be natural sand consisting of fine granular material resulting from the natural disintegration of rock or manufactured sand or a combination thereof. The sand shall consist of clean, sound, durable particles free from any adherent coating, clay lumps, or other deleterious substances, and at the time of use shall be entirely free of frozen material. Fine aggregate shall conform to the requirements of the current MDOT Standard Specifications for fine aggregates for Portland cement concrete, natural sand, Type 2NS.

E Coarse Aggregate

1. Coarse aggregate shall consist of gravel, stone or slag all of which shall conform to the current MDOT Specifications for Type 6AA. Coarse aggregate shall be used in all concrete permanently exposed to the weather.

F Admixtures

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1. Admixtures include all materials other than water, aggregates, and Portland Cement that are used in the making of concrete and that are added to the batch immediately before or during the mixing.
2. Admixtures, other than Air-Entraining admixture conforming to the requirements of ASTM C260, shall not be used in the concrete without the prior written approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
3. Admixtures that may be used with written approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT are Calcium Chloride per ASTM D8, Type 1 regular flake and water reducing admixtures ASTM C494 Type A and Type D.

G Joint Materials

1. Filler for expansion joins shall be pre-molded bituminous, ASTM D1751. Filler for contraction joints shall be bituminous joint filler, AASHTO M33. Filler for curb expansion and contraction joints shall be pre-molded bituminous, ASTM D1751 or AASHTO M213 Type III.
2. Poured joint filler shall be hot-poured rubber-type compound.

H Forms

1. Pavement and curb forms shall be straight and free from distortion, and of sufficient strength to resist forces applied during the process of placing concrete against them. The forms shall be of an approved section, with a flat surface on top, and shall be of the full depth of the pavement or curb.
2. Forms for radius corners shall be steel or thin board, accurately formed to true radius, and held by bracing and stakes to maintain a true curve.

I Fill Materials

1. Earth materials excavated under this Contract, to be suitable for backfill behind the curb or integral curb and sidewalk, the filling of low places in a strip 2 feet (61.0 cm) wide and paralleling the constructed curb, and integral curb and sidewalk shall be a type that may be thoroughly compacted by the method specified. Such material, to be useable, shall be free from rubbish or debris, vegetable matter, large stones, concrete fragments or other road material, lumber, tree roots, or branches. In general, select excavated material to be suitable for backfill shall be restricted to sand or crumbly clay, unless indicated otherwise.

2.2 PROPORTIONING

A Design Mixture

1. The mixing proportions (approximately 1:2:3 mix) and water-cement ratio used shall be such as to produce a dense, homogenous, workable, and durable concrete having a minimum compressive strength of 4,000 psi (27,579 kPa) at 28 days, unless indicated otherwise on the Drawings.
2. The concrete mix design to produce a concrete of the required minimum strength shall be the sole responsibility of the Contractor, except that no less than 6 ½ sacks of cement per cubic yard (8 ½ sacks of cement per cubic meter) shall be used and the mixing water shall not be more than 5 ½ gallons (20.8 liters) per sack of cement, including the surface moisture carried by the aggregates, both fine and coarse. The maximum allowable slump shall be that consistent with the proper placement of the mix, but in no case shall the water content exceed that specified. The Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT will check the Contractor-DO NOT USE!!! Use "Contractor's Spec Term"

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GT's proposed concrete design mix. Mixes which do not produce concrete of required quality shall be adjusted, at the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT's sole expense, until all the requirements of these specifications are complied with.

3. The Grade of concrete to be used in the various parts of the work shall be as stipulated below, unless otherwise called for on the Plans.
   a. Grade "A" Use
      1) Concrete Pavement
      2) Curbs
      3) Commercial Drives
      4) Pavement Base
      5) Residential Drives
      6) Sidewalks
   b. Grade "C" Use
      1) Backfill where Called for on Plans
      2) As Directed by the Engineer
4. Grade "A" concrete may be used in the place of Grade "C" concrete, without additional cost to the Owner.
5. High-Early-Strength Concrete installation and mix design shall be subject to the approval of the Engineer for each location shown on the Plans, or as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.

PART 3 - EXECUTION

3.1 INSPECTION

A Verify compacted subgrade or granular base as applicable is acceptable and ready to support paving, curbs, curb and gutter, integral curb and sidewalk, and imposed loads.

B Verify gradients and elevations of subgrade or base are correct.

3.2 PREPARATION

A Prepare subgrade or base in accordance with the MDOT Standard Specifications for Construction unless indicated otherwise on the drawings. Replace unsuitable subgrade soils with approved suitable materials. Moisten base to minimize absorption of water from fresh concrete.

B Coat surfaces of manhole, catch basin, and other metal frames and covers with oil to prevent bond with concrete pavement.

C Notify Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT a minimum of 24 hours prior to commencement of concreting operations.

D Forming

1. Place a secure forms to correct location, dimension, profile, and gradient. Forms shall be adequately staked and braced to resist the pressure of the concrete. All forms shall be thoroughly cleaned and oiled before concrete is placed against them.
2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
3. Place joint filler vertically in position, in straight lines. Secure to formwork during concrete placement.

3.3 INSTALLATION

A Batching, Mixing, and Transporting Concrete

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1. Ready-mixed concrete from an approved source shall be used unless on-the-site mixing is authorized by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. The plan and transportation equipment and the methods used for producing and delivering the ready-mixed concrete shall conform to the current ASTM Standard C94 except as otherwise modified or specified herein.
2. The plant and transportation equipment of the ready-mix concrete source shall be available for assignment to this work and shall be of adequate size and sufficient capacity to maintain a satisfactory job progress schedule. Concrete materials shall be stocked in such quantities as required to meet maximum demands.
3. A "Transit Mix Concrete Producer's Certificate," furnished by the City Engineering Department, shall be used in lieu of the certification called for in ASTM C94. Such certificate, completely filled out and signed by an authorized agent of the producer, shall accompany each truck load of ready-mix concrete and be presented to the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT or Inspector prior to unloading at the site as a condition for the use of concrete in the work. The person signing shall be one who has previously been officially designated by the producer as authorized agent and whose signature is currently on file with the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT for Owner - DO NOT USE!!! Use "Owner's Spec Term" GT.
4. The Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT's determination of "Failure to Meet Strength Requirements" of ASTM C94, shall be final and conclusive upon the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT. Such determination will be based on tests and other factual data deemed pertinent by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
5. On-the-site batching and mixing equipment and methods, when authorized, shall be such that will produce concrete comparable in all respects to ready-mixed concrete meeting and specified requirements.

B Erection

1. Curbs of all types shall not have reinforcing steel extend through transverse expansion and contraction joints.

C Separate Type Curb Construction – Unreinforced and Reinforced Construction

1. The curbs shall be constructed in conformance with the types and details as specified on the plans. When steel reinforcement is called for on the plans, it shall be properly spaced and held in the correct position during the placing of concrete by the use of devices or methods meeting the approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
2. Splicing of steel reinforcement bars shall be accomplished by lapping and securely wiring the bars together. The bars shall be lapped at least 10 inches (25.4 cm), unless otherwise shown on the Plans.
3. The concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface.
4. Joints shall be constructed perpendicular to the surfaces of the structure and shall not vary more than ¼ inch (6.4 mm) from their designated positions.

5. Expansion joints in un-reinforced curb shall be 1 inch (2.54 cm) thickness, with curb size pre-molded bituminous fiber filler, shall be placed through the curb at the end of the street returns at 50 feet (15.2 m) intervals, or at such lesser distances when necessary to retain the 50 food (15.2 m) interval between existing expansion joints remaining.
6. Expansion joints in reinforced curb shall be 1 inch (2.54 cm) thickness, with curb size pre-molded bituminous fiber filler, shall be placed through the curb at the end of street returns and in line with all expansion joints in the abutting pavement.
7. The curb shall be constructed in uniform sections of a length not longer than 10 feet (3.1 m) except when otherwise shown on the plans. Provide separation joints at 10 food (3.1 m) intervals between expansion joints. Separation joints shall be formed by a steel template 1/8 inch (3.2 mm) in thickness, of a width equal to the required width of the curb, and depth of at least 2 inches (5.1 cm) greater than the required depth of the curb, set vertically within the forms and at right angles to the curb face. Finding of separate type curb shall be as specified for Reinforced Curb and Gutter.

D Reinforced Integral Curb and Gutter Construction

1. The reinforced integral curb and gutter shall conform to the cross-section shown on the plans. The reinforced integral curb and gutter shall be constructed to the grade shown on the Drawings, unless otherwise directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. Integral curb shall be constructed monolithic with the pavement slab. The curb material shall be placed before the pavement has started its initial set, and shall be of the same mix and be identical to the concrete in the pavement.
2. The curb and gutter forms shall be substantial and so placed and held as to be unyielding during the placing, compaction, and curing of the concrete.
3. The concrete shall be carefully placed to avoid segregation and shall be sufficiently spaded or vibrated to eliminate all voids and taped to bring the mortar to the surface.
4. The longitudinal bards called for on the plans shall be properly spaced and held in correct position during the placing of concrete by use of bar chairs, hangers, or other devices approved by the Engineer. Longitudinal bars shall end 2 inches (5.1 cm) from each expansion or contraction joint.
5. Splicing of steel reinforcement bars shall be accomplished by lapping and securely wiring the bars together. The bars shall be lapped at least 10 inches (25.4 cm).
6. Expansion joints of ½ inch (1.3 cm) thickness, with curb size pre-molded bituminous fiber filler shall be placed through the curb at 60 foot (18.1 m) intervals, or at such lesser distances when necessary to retain the 60 foot (18.1 m) intervals between existing expansion joints remaining.
7. The bottom of the pre-molded filler shall be set 1 ½ inches (3.8 cm) below the bottom of the pavement. The joint shall be free from concrete and the end of the joint cleaned of hardened concrete as soon as the forms are removed.
8. During installation, the joint shall be held in place by an approved installing device which shall be securely staked. The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10 gage (3.5 mm) thickness material having flanges not less than 1 ½ inches (3.8 cm) in depth. The channel cap shall be shaped to the contour of the pavement and shall extend over the filler from gutter line to edge of pavement. A pre-molded filler of the full depth, width, and cross-section of the

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curbs shall be placed at the channel cap end and shall make a positive separation between curb and gutter sections.

9. Reinforced integral curb and gutter shall be constructed in uniform sections of a length not longer than 20 feet (6.1 m). Provide separation joints at 20 foot (6.1 m) intervals between expansion joints shall be formed by a steel template, 1/8 inch (3.2 mm) thickness, of a width equal to the required width of the curb and gutter and depth of at least 2 inches (5.1 cm) greater than the required depth of the curb, set vertically within the forms and at right angles to the curb face.
10. The edges and back top edge of the curb and all transverse joints and planes of weakness shall be rounded with an approved finishing tool having a radius of ¼ inch (6.4 mm). The face of the curb, at the top of all curb and at the bottom of the integral curb, shall be rounded with approved finishing tools having the radii shown on the plans. When the concrete has set sufficiently to prevent slumping the face form shall be removed and the exposed surfaces of the concrete curb or curb and gutter shall be finished smooth and even by means of a moistened wood float, followed by a light brushing, using either a broom, brush, or burlap. The top of curb shall not vary more than 3/16 inch in 10 feet (4.7 mm in 3.1 m) when checked with a 10 foot (3.1 m) straightedge. The balance of the exposed surfaces shall not vary more than 3.8 inch (9.5 mm) from the alignment and typical cross-section.
11. Water shall not be added to the concrete surface as an aside to finishing, except in isolated instances where a delay in finishing has occurred and evaporation has caused a loss of surface moisture. Water added in these instances shall be minimal and then only when approved by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
12. Honeycombed areas and minor defects shall be filled with mortar, prior to applying membrane curing compound. Use mortar conforming to Type R-2 per the MDOT Standard Specifications for Construction unless indicated otherwise on the drawings.

E Integral Curb and Sidewalk

1. Integral curb and sidewalk shall conform to the cross-section shown on the plans and shall be constructed in a similar manner to curbs specified herein. Sidewalk portion shall have a broomed finish.

F Road Pavement Joints

1. All transverse joints in the concrete pavement shall extend entirely through the integral curb. The edges of the transverse joint in the curb shall be rounded with an approved finishing tool having a radius of ¼ inch (6.4 mm).
2. Joints in the integral curb shall be sealed with Hot-Poured Rubber-Asphalt type compound as specified in the MDOT Standard Specifications for Construction.
3. Transverse contraction joints per MDOT Road Standard Plan shall be placed at the locations shown on the plans and elsewhere at maximum intervals of 25 feet (7.6 m) between expansion joints. The minimum distance between any load transfer joints shall be 12.5 feet (3.8 m).
4. Expansion joints per MDOT Road Standard Plan, and expansion joints with load transfer assemblies shall be placed at locations shown on the plans and at locations as follows:
   a. At the “spring lines” of street returns.

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b. At the P.C. and P.T. of horizontal curves where the degree of curvature is 2 degrees 30 minutes or more. These joints may be omitted during the period from September 15th to April 15th, as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
c. Where necessary to relieve horizontal pressures at sharp vertical curves where shown on the plans or as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.
d. During the period from September 15th to April 15th, expansion joints shall be spaced at maximum intervals of 315 feet (96.0 m), this includes a full-width expansion joint for any portion of multiple-lane pavement placed during this period.
e. End-of-pour-joints shall be placed at the location of full width pavement and the start of non-reinforced temporary transition tapers as shown in MDOT Road Standard Plan, or as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.

G Concrete Base Course Joints

1. All joints shall conform to the details and position shown on the plans, with the following exceptions:
   a. Joints in Unreinforced Concrete Base Course:
      1) Sawed transverse contraction joints shall not be required.
   b. Joints in Reinforced Concrete Base Course:
      1) A load transfer unit shall not be required for transverse contraction joints. The pavement reinforcement shall be continuous through the joint.
   c. Joint Filler:
      1) Joints shall not be filled with poured joint filler. Pre-molded joint filler shall be placed with its top edge ½ inch (1.3 cm) below the pavement surface.

H Reinforcement

1. Pavement reinforcement shall be placed as specified in the MDOT Standard Specifications for Construction, except that adjacent sheets or mats shall be lapped approximately 1 foot (30.1 cm) and that pavement reinforcement shall stop 6 inches (15.2 cm) from all expansion or contraction joints.
2. On the outside of 13.5 foot (4.1 m) lanes, pavement reinforcement for a 12 foot (3.7 m) lane shall be used with no reinforcement for the outside 1.5 feet (45.7 cm) of pavement and curb.
3. Tie-bars shall be epoxy-coated. Damaged areas shall be repaired before placing concrete. Bent tie-bars shall be inspected after straightening, and any damaged epoxy coatings shall be repaired before embedment in concrete.
4. Expansion-anchored lane-ties shall be of the size and spacing shown on plans. They shall be either the self-drilling flush type, pre-drilled flush type, or the pre-drilled torque type. Expansion-anchored lane-ties shall replace broken bent lane tie-bars in longitudinal bulkhead joints at the Contractor’s expense.
5. Load transfer assemblies used in 13.5 foot (4.1 m) lane widths shall be 11.5 feet (3.5 m) long. They shall be placed in the inside 12 feet (3.6 m) of the outside curb lane.

I Placement

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1. The concrete shall be distributed or spread as soon as placed. The concrete shall be deposited on the subgrade in such a manner as to require as little re-handling as possible. Any additional spreading required shall be done by means of shovels. The method and manner of placing shall be such as to avoid segregation and separation of the materials. The concrete shall be distributed to such depth and sufficiently above grade so that when consolidated and finished, the surface shall conform to the required finished grade. The concrete along the faces of the forms and adjacent to joints shall be consolidated and compacted to fill all voids and insure a dense smooth surface.
2. The depositing and spreading of the concrete shall be continuous, as far as possible, between transverse joints. In the case of a temporary shutdown, the concrete at the unfinished end of the slab shall be covered with wet burlap. In the event of an unavoidable interruption of the work continuing more than ½ hour, a construction joint shall be placed provided the section is 10 feet (3.1 m) or more in length between joints. Sections less than 10 feet (3.1 m) in length shall not be permitted, and if constructed shall be removed.
3. The entire area of the pavement shall be so consolidated as to ensure a minimum of voids. The concrete shall be struck off with a screed to the cross-section and thickness shown on the plans. The screed shall be set on side forms and upon a temporary center form or guide.
4. In all cases the minimum thickness of the pavement shall be the thickness shown on the plans.
5. Cement mortar gathered from the surface of the concrete already placed shall not be used for filling boot tracks or stony areas. Such areas shall be dug out, refilled with concrete, and worked smooth.
6. After striking off, the surface shall be finished to a gritty texture by means of a wooden float. If a metal float is used for final finishing, no more than two passes may be made over the surface.

J Texturing of Concrete Pavement

1. Texturing of Concrete pavement shall be in accordance with the MDOT Standard Specifications for Construction, except as follows:
   a. As soon as the concrete has set sufficiently to maintain a texture, the concrete surface shall be dragged longitudinally with a stiff fiber artificial grass carpet.
   b. Under unusual conditions, the following texturing method may be utilized, if approved by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT:
      1) As soon as all excess moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement surface shall be dragged longitudinally using a Monsanto Astroturf Mat, or approved equal, to a degree of texturing as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. The astroturf mat shall be suspended from a movable bridge and shall be in full longitudinal contact with the pavement surface for a minimum distance of 3 feet (91.4 cm). This method of texturing shall apply to concrete pavement only, not to concrete base course.

2) The texturing mat shall be kept free from accumulations of concrete mortar by removing the mat from the movable bridge and flushing the mat with water, or by other means approved by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. The texturing mat shall be replaced when the mortar accumulations harden and cannot be removed.

K Sawing Joints

1. Joints shall be sawed in accordance with the details shown on the plans and in accordance with the current MDOT Standard Specifications for Construction.

L Texturing (Finishing)

1. When the water sheen has practically disappeared, the pavement surface shall be textured (finished) by use of an approved broom or brush. The texturing operations shall produce uniform corrugations approximately 1/16 inch (1.6 mm) in depth and approximately at right angles to the centerline of the pavement. Texturing shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operations. The finished surface shall be free from rough or porous areas, irregularities and depressions resulting from texturing operations and shall meet the approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. Brooms or brushes for texturing the pavement surface shall be of such material and design that they will be capable of producing uniform corrugations of the specified depth.
2. Final surface finishing of concrete base courses shall be as specified above except the pavement shall be rough broom finished.

M Form Removal

1. Pavement forms shall not be removed from freshly placed concrete until it has set for at least 24 hours. After the form pins have been removed, the forms shall be carefully removed so that no damage will be done to the edge of the pavement.
2. After the forms have been removed, the ends of all concrete joints shall be cleaned and all honeycombed areas pointed. Such honeycombed areas shall be covered with wetted burlap until the pointing has been completed, after which the area shall be cured as specified below.

N Patching of Transverse and Longitudinal Joints

1. The patching of transverse and longitudinal joints shall conform to the specific requirements of the MDOT Standard Specifications for Construction on concrete pavement and construction.

O Protection

1. Fresh concrete pavement and integral curb shall be protected from rain and freezing, and the Contractor shall make this possible by keeping available sufficient covering material. The exposed surface of the concrete shall be protected from premature drying for a period of seven days after pouring.
2. Sufficient barricades and lights shall be provided to prevent traffic upon the concrete pavement for seven (7) days or for three (3) days if high-early strength concrete was used, unless such interval shall be modified when deemed necessary by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT.

P Curing

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1. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of membrane curing compound in accordance with the current MDOT Standard Specifications for Construction and as specified herein. The compound shall be thoroughly stirred to a uniform consistency in the drum just prior to transfer of the compound to the membrane spraying equipment. Curing compound shall not be thinned.
2. The curing compound shall be applied at a minimum rate of 1 gallon per 200 square feet (1 liter per 4.9 square meters) of surface. For miscellaneous concrete pavement over one lane in width, where a manually operated pressure-type sprayer is used, the compound shall be applied from a foot bridge. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT will be required to apply a new coat of material to the affected areas equal in curing value to that specified for the original coat.
3. Curing of concrete base courses shall be ass specified above except that transparent membrane curing compound shall be used.
4. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the work, such as sawing joints, provided any damage to the film is immediately repaired by another application of compound. If fixed-forms are removed during the curing period, the entire area of the sides of the slab shall be coated with curing compound immediately after removal of the forms. Approved hand-spray equipment will be permitted for the application of the curing compound on the sides of the slab and for repairing damaged areas.
5. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.
6. When approved by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT, curing compound may be omitted when cold-weather protection is used during the curing period.

Q Cold-Weather Protection

1. No concrete shall be placed after November 1, and prior to May 1, without specific written authorization of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. Without exception, all costs associated with placing concrete in cold weather shall be the responsibility of the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT.
2. If the authorization is given to place concrete during this period and the use of high-early strength concrete was not originally specified, the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT may require the use of high-early strength concrete at no extra cost. In any case, concrete shall be adequately protected when necessary from cold weather and freezing and precaution s taken to prevent any damage to the concrete from low temperatures.
3. Frozen concrete or concrete otherwise damaged from cold weather shall be removed and replaced with sound concrete at the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT's expense. When low air temperatures are probably, a plan and method for

protecting the concrete during its early stages shall be adopted, subject to the approval of the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT and in conformity with the limiting requirements herein. Only such methods shall be used that will maintain reasonably uniform temperatures and provide proper moisture conditions for curing. All required materials, special equipment and facilities needed to provide the adequate provisions shall be readily available before the low temperature actually occurs.

4. The subgrade shall not be frozen when pouring concrete. When necessary to excavate below subgrade to remove frozen material, the excavated space below the subgrade shall be refilled with unfrozen crushed stone, gravel or sand, but not with clay or loam. If such suitable materials are not available for backfill, then concrete shall be used for the full depth of the excavation.
5. Whenever it is anticipated that the air temperature at the point of concrete placement is likely to be 40 degrees F (4.4 degrees C) or lower during the 24-hour period following the pouring, or below 30 degrees F(-1.1 degrees C) during the succeeding seven days, protective measures shall be taken.
6. At times when prevailing air temperatures will produce concrete of less than 65 degrees F (18.3 degrees C), mixing water shall be heated. Concrete materials entering the mixture shall be free of lumps, frost, snow, or ice. When necessary, the concrete materials shall also be heated so as to produce a concrete having a temperature of not less than 65 degrees F (18.3 degrees C), not more than 90 degrees F (32.2 degrees C) and as near 70 degrees F (21.1 degrees C) as possible at the time of pouring. The heating of the materials shall be done in a manner and by such methods as will keep the materials clean and free from injurious substances. The heating of the mixing water and aggregates shall be controlled so that there will be no large differences in temperature form batch to batch. The maximum temperature for the heated water and fine aggregate shall not exceed 150 degrees F (65.6 degrees C), and that of the heated coarse aggregate shall not exceed 100 degrees F (37.8 degrees C). Salt or other chemicals shall not be added to prevent freezing.
7. Calcium chloride shall be added to concrete mixture to accelerate the hardening of the concrete under conditions stipulated below. The calcium chloride shall be added to the concrete mixture only in solution in water and not in dry flake form. The maximum amount of calcium chloride that may be added is 2 percent of the weight of the cement in the batch, or slightly less than 2 pounds (0.9 kilograms) per standard sack of cement.
8. The solution shall be made up on the basis of 4 pounds of flake calcium chloride in 1 gallon (0.48 kilograms in 1 liter) of hot water. The solution shall be considered as part of the total allowed concrete mixing water, unless authorized by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. Thus, if a 1 percent calcium chloride mix is needed, 1 quart (0.95 liters) of the solution is added per bag of cement. If a 2 percent calcium chloride is needed, then 2 quarts (1.9 liters) of solution is added per bag of cement.
9. Concrete which will be deposited when the predicted air temperature is in a range listed below, shall be prepared in accordance with the provision stipulated for the applicable range.
    a. 40 degrees to 30 degrees F (4.4 degrees C to -1 degrees C):
        1) 1 percent calcium chloride added to concrete mix.

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b. 28 degrees F (-2.2 degrees C) and rising:
   1) 1 percent calcium chloride added to concrete mix and heated mixing water used.
c. 35 degrees F (1.7 degrees C) and rising:
   1) Either or both of above requirements may be omitted.
d. 40 degrees F (4.4 degrees C) or lower before dark:
   1) 1 percent calcium chloride added to concrete mix for concrete that will be poured after 1:00 p.m., to accelerate setting to allow completion of finishing operations and covering within daylight hours.

10. Concrete when being placed shall have a temperature within the range specified. Forms shall be free of ice, snow and frost at the time of pouring concrete and the subgrade shall not be frozen. The poured concrete shall be protected to provide for a minimum of 3 Days with a minimum temperature of 55 degrees F. If concrete is “high early” concrete, 2 days will be permitted. Additionally, the maximum allowable rate of cooling once temperature protection is removed is 1) Maximum of 5 degrees F in any one hour and 2) Maximum allowable drop of 50 degrees F in first 24 hours.
11. Marsh hay or straw shall be used for a protective covering unless another equally effective means is approved by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. Where necessary to maintain the required minimum temperatures, the hay or straw shall be covered with tarpaulins, or other approved materials, securely weighted against displacement by wind.
12. A high-low thermometer shall be furnished and installed as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT to record the maximum and minimum temperature of the concrete. Periodic inspections shall be made to assure the protective covering is properly maintained in place. Any concrete damaged by freezing or overheating shall be removed and replaced with sound concrete at the Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT’s expense.

R Backfilling

1. After the concrete has gained sufficient strength, the remaining excavated areas shall be backfilled with approved material, compacted thoroughly, and left in a neat condition. Provide suitable backfill as specified herein if excavated material is insufficient in quantity or unsuitable for backfill.
2. Compaction shall be to at least 95 percent of the maximum unit weight.

S Cleaning

1. Any concrete spilled on the pavement or structures shall be removed and the pavement or structures thoroughly cleaned before the concrete sets. Spilled concrete shall not be washed into sewers or drains. The site of the work shall be restored to a neat and clean appearance, including the removal of excess earth, material, forms, and equipment.

3.4 FIELD QUALITY CONTROL

A Before final acceptance of the pavement, cores will be taken from the pavement after placement to determine the compressive strength at 28 days, the thickness of the pavement, and the depth of pavement reinforcement below the pavement surface. The Contractor-DO NOT USE!!! Use "Contractor's Spec Term" GT shall be required to hire a testing laboratory, to perform testing of the installed concrete pavement.

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B The frequency of coring will be based on pavement units. The width of a unit is a lane. The width of each lane is determined by mandatory and/or optional joints indicated on the cross sections shown on the plans, except that thickened edges of lanes will not be included in the lane widths. The length of a unit will be 250 linear feet (76.2 linear meters) or any fraction thereof.

C Coring the Pavement

1. An initial 6 inch (15.2 cm) core shall be taken from each prescribed unit through the entire thickness of the pavement at such times and locations as directed by the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT. The cores shall be drilled and handled in accordance with ASTM C42.

D Measuring and Testing the Core

1. Each core shall be measured for thickness of concrete and depth of steel reinforcement and tested for compressive strength at 28 days after placement.
2. The measurement for length of core, depth of reinforcement, and the averaging of measurements when more than one core is taken from a unit, will be reported to the nearest 0.1 inch (3 mm) in accordance with the Rounding-Off Method of ASTM E29.

E Measurement for Thickness of Pavement

1. The length of a core for determining pavement thickness shall be determined by average measurements of the core in accordance with AASHTO T148.
2. When averaging core lengths, measurements which are in excess of specified pavement thickness by more than 0.2 inches (5.1 mm) will be considered as the specified thickness plus 0.2 inches (5.1 mm).

F Measurement for Depth of Reinforcement

1. Measurements for depth of reinforcement will be made from the top surface of the core to the top of the longitudinal bar or wire. If a core does not include a section of pavement reinforcement, an additional core will be taken not less than 10 feet (3.1 m) nor more than 10 feet (3.1 m) ahead of the core. This additional core will be used for the determination of the depth of pavement reinforcement and not for the measurement of pavement thickness.

G Determination of Compressive Strength

1. The compressive strength at 28 days after placing shall be determined according to ASTM C42. The core shall be classified in accordance with the results of the measurement for concrete thickness, the depth of steel and the compressive strength in accordance with the ranges indicated in Tables 1, and 2.
2. The Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT shall be furnished with a certified report of such measurements and tests. After making such measurements and tests, the cores shall be delivered to the Engineer-DO NOT USE!!! Use Design Professional's Spec Term GT for further checking and tests.

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Table 3 - Classification of Cores for Pavement Deficient in Thickness

Core Type	Deficiency in Thickness Determined by Cores, Inches (mm)
A	0.2 (5 or less)
B	0.3 (6 to 9)
B	0.4 (10 to 12)
B	0.5 (13 to 15)
B	0.6 to 1.0 (16 to 26)
C	1.1 (27) and over

Table 4 - Classification of Cores for Reinforced Concrete Pavement where Reinforcement is out of Tolerance.

Depth Range of Reinforcement, inches (mm)

Core Type	Pavement Thickness		
	7 ½ - 8 ½ (190 – 219) inches (mm)	8 ½ - 9 ¾ 220 – 249 inches (mm)	9 ¾ - 11 250 – 279 inches (mm)
Z	0 – 1 (0 – 24)	0 – 1 (0 – 24)	0 – 1 (0 – 24)
X	1 – 2 (25 – 49)	1 – 2 (25 – 49)	1 – 2 1/4 (25 – 59)
W	2 – 4 (50 – 99)	2 – 4 ¼ (50 – 110)	2 1/4 – 5 ¼ (60 – 134)
X	4 – 5 (100 – 124)	4 1/4 – 5 1/2 (111 – 139)	5 1/4 – 6 ¼ (135 – 159)
Y	5 – 6 (125 – 152)	5 1/2 - 7 1/4 (140 – 184)	6 1/4 – 8 ¼ (160 – 209)
Z	6 & over (165 & over)	7 1/4 & over (185 & over)	8 1/4 & over (210 & over)

a. When a core length measures 1/10 inch (3 mm) or more over the plan thickness, the maximum depth range will be increased by ½ of the excess core length over the plan thickness. For each core, the increase will be rounded off to the nearest 1 mm in accordance with rounding-off method of ASTM E29 and then added to the range shown.

H Additional Coring Requirements for Pavement Deficiencies

1. When the initial core from a pavement unit is classified as Type AW, no additional cores will be taken from that pavement unit.
2. When the initial core from a pavement unit is classified as other than Type AW, additional cores will be taken. The additional cores will be measured only for the defect that required the taking of the additional cores. Additional coring requirements for the various core types will be as follows:
   a. When core measurements indicate the core to be one of Types AX, AY, BW, BX, and BY, two additional cores will be taken within the pavement unit. When the coring is being done on a linear foot (meter) basis, one additional core will be taken not less than 10 feet (3.1 m) nor more than 300 feet (91.4 m) in each direction from the initial core.

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SECTION 32 92 19.13
TOP SOILING, SEEDING AND SODDING

PART 1 GENERAL

1.1 SCOPE

A The work covered by this Section consists of furnishing all labor, equipment and material required to place topsoil, seed, commercial fertilizer, agricultural limestone and mulch material, including seedbed preparation, harrowing, compacting and other placement operations on graded earthen areas as described herein.

B Seeding operations shall be conducted on all newly graded earthen areas not covered by structures, pavement or sidewalks; all cleared or grubbed areas which are to remain as finish grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.

C The Work shall also include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion.

1.2 SUBMITTALS

A Submittals shall be made in accordance with the requirements of the Contract, and Section 01 33 00 Submittals. In addition, the following information shall be submitted to the Owner for the Project record:

1. Prior to seeding operations, labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this Section.
2. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from a certified testing laboratory.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A Wood cellulose fiber mulch shall be manufactured by Weyerhauser Company or Conway Corporation or equal.

2.2 MATERIALS AND CONSTRUCTION

A Topsoil

1. Utilizing stockpiles or borrow areas on site, the Contractor shall place a minimum of 6-inches of topsoil over all graded earthen areas and over any other areas to be seeded.
2. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than 1/2-inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.

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3. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam or a combination thereof. The pH shall range from 5.5 to 7.0. Topsoil shall contain not less than 5 percent nor more than 20 percent, by weight, or organic matter as determined by loss on ignition of oven dried samples to 65 Degrees C.

B Seed

1. Seed shall be hulled common Bermuda (Cynodon Dactylon) guaranteed by the dealer to be 98% minimum purity and 90% minimum germination and certified free of giant strain Bermuda.
2. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
3. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet or otherwise damaged in transit or storage.
4. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Owner, samples of seed may be taken for check against the grower's analysis.
5. Species, rate of seeding, fertilization and other requirements are shown in Table 1 at the end of this Section.

C Fertilizer and Liming Materials

1. Fertilizer and liming materials shall comply with applicable State of Georgia, local and federal laws concerned with their production and use.
2. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in Table 02933-1. Container bags shall have the name and address of the manufacturer, the brand name, net weight and chemical composition.
3. Agricultural limestone shall be a pulverized limestone having a calcium carbonate content of not less than 85 percent by weight.
4. Fertilizer shall be a complete fertilizer, the content of which shall meet the following minimum requirements: 10% nitrogen, 10% phosphoric acid, 10% potash, available materials. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to the site in original unopened containers bearing the manufacturer's statement of guarantee.
5. Ammonium Nitrate shall be a standard brand and shall be delivered to the site in original unopened containers. It shall contain not less than 33-1/3% Nitrogen.

D Mulch Material

1. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
2. Mulch shall be composed of wood cellulose fiber, straw or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.
3. Straw mulch shall be partially decomposed stalks of wheat, rye, or oats.
4. Stalks shall be the partially decomposed, shredded residue of corn, cane, or sorghum.

E Mulch Binder

1. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of a mulch binder. The mulch binder shall be non-toxic to plant life.

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2. Emulsified asphalt binder shall be Grade SS-1, ASTM D977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

F Inoculants for Legumes: All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen fixing bacteria that is adapted to the particular seed involved.

G Water: Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

H Sod

1. Sod shall be living, growing sod of Bermuda hybrids "Tifway 419" or Tifgreen 328". This includes sod which is dormant during the cold or dry season and capable of renewing growth after the dormant period. All sod shall be obtained from qualified, established sources. The presence of weeds or other noxious growth or any other foreign material which may be detrimental to the proposed planting will be cause of rejection. At least 85% of the plants in the sod shall be composed of the designated variety of Bermuda grass.
2. The sod will be subject to inspection by Owner while it is being planted and any material which has been permitted to dry out excessively or exposed to extreme heat, or which is not viable, will be rejected.
3. In the harvesting of the sod, grass more than 3-inches tall shall be mowed to a height of 3-inches, raked and removed before sod cutting begins. The sod shall be cut into square or rectangular sections which may vary in length, but which shall be of uniform width and thickness, and shall have at least ½-inch of soil adhering firmly to the roots. Care shall be exercised at all times to retain the soil on the roots of the sod during the process of cutting, transporting and planting. Sod shall be transplanted within 24 hours from the time it is harvested. All sod stored shall be kept moist, shall be protected from exposure to the air and sun and from freezing, and shall not be stored for more than 10 days. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected.

PART 3 EXECUTION

3.1 SECURING AND PLACING TOPSOIL

A Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods.

B The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.

C All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen or its residue and any other refuse which will hinder or prevent growth.

D In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if the material cannot be removed the pit shall be abandoned.

E Before placing or depositing topsoil upon any areas, all improvement within the area shall be completed.

F The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.

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3.2 SEEDBED PREPARATION

A Before liming, fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line from unsightly variation, bumps, ridges and depressions and all detrimental material, roots and stones larger than 3-inches in any dimension shall be removed from the soil.

B Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2-inches with a weighted disc, tiller, pulvimixer or other equipment, until the surface is smooth and in a condition ready to accept seed.

C If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be cultivated for seeding.

D Ground preparation operations shall be performed only when the ground is in a tillable and workable condition.

3.3 FERTILIZATION AND LIMING

A Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in Table 02933-1 at the end of this Section.

B Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2-inch.

C Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.

D Agricultural limestone shall be thoroughly mixed into the soil according to the rates in Table 02933-1. The specified rate of application of limestone may be reduced if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests to determine any adjustment in rates.

E It is the responsibility of the Contractor to make one application of a maintenance fertilizer according to the recommendations listed in Table 02933-1.

F Spread 20 lbs. per 1,000 sq. ft. of 10-10-10 fertilizer into top 3-inches, hand rake and smooth. The surface shall be brought to finish grade requirements, allowance being made for settlement. Finish grades shall be smooth and free from hollows or other inequalities.

G Three weeks after construction of lawns add ammonium nitrate at the rate of 5 lbs. per 1000 sq. ft. of lawn area, and thoroughly water in.

3.4 SEEDING

A Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in Table 02933-1. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.

B Seed shall be uniformly sown by mechanical method suitable for the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder or mechanical power drawn seed drills. Hydro-seeding and hydro-mulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

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C Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8-inch by a cultipacker or suitable roller.

D Leguminous seeds shall be inoculated prior to seeding with a compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instructions.

E Italian rye grass (Lolium Multiflorum) shall be evenly seeded with a mechanical spreader at the rate of 5 lbs. per 1000 sq. ft. of area, lightly rake, suitably compact and thoroughly water. Before planting the permanent lawn, the rye shall be thoroughly scarified in a manner to incorporate it into the top three inches of the ground.

F The planting of Bermuda grass shall be done only within the season extending from April 15 to August 1.

3.5 MULCHING

A All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.

B One of the following mulches shall be spread evenly over the seeded areas at the following application rates:

Wood Cellulose Fiber	1,400 pounds/acre
Straw	4,000 pounds/acre
Stalks	4,000 pounds/acre

C These rates may be adjusted at no additional cost to the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area.

D The Contractor shall cover structures, poles, fence and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

E Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates using standard industry practice.

3.6 WATERING

A The Contractor shall be responsible for maintaining the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain adequate water content in the soil.

B Watering shall be accomplished by hoses, tank truck or sprinklers in such a way to prevent erosion, excessive runoff and overwatered spots.

3.7 MAINTENANCE

A Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris and excess material and the premises shall be left in a neat and orderly condition.

B The Contractor shall maintain all seeded areas without additional payment until final acceptance of the work by the Owner, and any regrading, refertilizing, reliming, reseeding or remulching shall be done at the Contractor 's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished. Damage resulting from erosion, gulleys, washouts or other causes shall be repaired by filling with topsoil, compacting and repeating the seeding work at the Contractor's expense.

C Contractors’ warranty of one (1) year shall also cover a fully rooted stand of grass.

TABLE 1 SEEDING REQUIREMENTS

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Area	Sowing Season	Species	Seed	Rates per 1,000 Square Feet		
				Fertilizer	Limestone	Maintenance**
Flat to rolling terrain with slopes less than 3:1	3/1 to 4/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	10 lbs. 10-10-10
	9/1 to 11/15	Rebel II Turf-Type Tall Fescue	6-8 lbs.	30 lbs. 6-12-12	200 lbs.	15 lbs. 10-10-10
Embankments with slopes greater than 3:1	3/1 to 6/1	Crownvetch* Kentucky 31 Fescue	lb. lbs.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20
	8/1 to 11/1	Crownvetch* Kentucky 31 Fescue Annual Ryegrass	lb. lb. 2 lb.	30 lbs. 6-12-12	200 lbs.	10 lbs. 0-20-20

1. * Requires inoculation
2. ** Maintenance fertilizer shall be applied in early spring following initial establishment of cover

SECTION 33 05 13.16
PRECAST MANHOLES, FRAMES AND COVERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A This section specifies precast cementious concrete manholes. Furnish all labor, materials and equipment required to install precast concrete manholes, grade rings, frames and covers, and appurtenances as specified.

B Manholes shall be constructed and installed per GDOT and as specified.

1.2 REFERENCE STANDARDS

A This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

1. New and replacement manholes shall be constructed and installed per GDOT and the Contract Drawings.
2. Occupational Safety and Health Administration (OSHA).

1.3 SUBMITTALS

A Procedures: Section 01 33 00 - Submittal Procedures.

B Action Submittals:

1. Shop drawings, product data, materials of construction, and details of installation shall be submitted in accordance with Section 01 33 00 - Submittal Procedures. Submittals shall include the following:
2. Design calculations, sealed by a Professional Engineer licensed in the State of Georgia, indicating adequate strength to resist the vertical and lateral loadings including “H-20” wheel loadings, and buoyancy forces.
3. Base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478.
4. Concrete mix design.
5. Detail of pipe connection(s) to manhole.
6. Manhole frame and cover style and finish with notarized certificate indicating compliance with ASTM A48, Class 30.
7. Method of repair for minor damage to precast concrete sections.

8. Design data for precast concrete structures: sectional plan(s) and elevations showing dimensions, reinforcing steel placement, manhole covers, steps, baffle plates, and accessories.

C Informational Submittals:

1. Test reports for precast concrete structures: concrete test cylinder reports from an approved testing laboratory certifying conformance with specifications.
2. Manufacturers Installation (or Application) Instructions
3. Operation and Maintenance Data

D Close-Out Submittals:

1. Per Section 01 78 39 - Project Record Documents.

1.4 QUALITY ASSURANCE

A All material shall be new and unused.

B Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Owner. Inspection may be made at place of manufacture, at work site following delivery, or both.

C Materials will be examined for compliance with ASTM specifications, these Specifications and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.

D Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.

E Repair minor damage to precast concrete sections by approved method, if repair is authorized by Owner.

1.5 WARRANTY

A All materials supplied under this section shall be warranted for a period of 2-years by the manufacturer and the Contractor. Warranty period shall commence upon formal acceptance of the project by the OWNER.

B The materials shall be warranted to be free from defects in workmanship, design and materials. If the materials should fail during the warranty period, it shall be replaced or restored to service at no expense to the Owner.

C The manufacturer's warranty period shall run concurrently with the Contractor’s warranty period. No exception to this provision shall be allowed.

PART 2 - PRODUCTS

2.1 GENERAL

A Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

C Provide lifting lugs or holes in each precast section for proper handling.

2.2 PRECAST CONCRETE MANHOLE SECTIONS

A Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478, Local DOT or city/county agency reference and meet the following requirements:

1. Bottom slab thickness shall equal the riser wall thickness or flat slab top thickness, whichever is greater.
2. Unless otherwise specified, top section shall be eccentric cone where cover over pipe exceeds 4 feet; top section shall be flat slab where cover over top of pipe is 4 feet or less, or where shown.
3. Base, riser and transition top sections shall have tongue and groove joints.
4. Sections shall be cured by an approved method.
5. Ship precast concrete only after concrete has attained 3,000 psi compressive strength.
6. Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum H-20 loading plus earth load. Calculate earth load with a unit weight of 130 pcf. Calculate buoyancy forces based on groundwater depth 1-foot below the ground surface.
7. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.
8. Construct and install precast concrete base as shown on the Drawings.
9. Portland cement shall be ASTM C150, Type II.

2.3 MANHOLE FRAME AND COVER

A Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30, and Local DOT or city/county agency reference.

B Manhole covers shall be NEENAH R-1695, or equal. Manhole frames shall be NEENAH R-1695.

C The letters “CLIENT OR LOCAL AGENCY” and “CONFINED SPACE”, of size and letter type acceptable to the Owner, shall be cast into each manhole lid.

2.4 JOINTING PRECAST MANHOLE SECTIONS AND STRUCTURES

A Seal tongue and groove joints of precast manhole and structure sections with either rubber “O“-ring gasket or preformed flexible joint sealant. “O“-ring gasket shall conform to ASTM C443.

B Preformed flexible joint sealant shall be Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Company or equal.

C Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.5 PIPE CONNECTIONS TO MANHOLE

A Connect pipe to manhole in the following ways:

1. Precast manhole connections shall be watertight in accordance with ASTM C-923.
2. Flexible Sleeve
   a. Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bitumous material to protect from corrosion. Flexible sleeve shall be

Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

3. Compression Gasket
   a. Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A All excavation, temporary shaft supports, sheeting and shoring, foundation cushion, concrete and grout required to support the walls of shafts and necessary to construct the manholes as shown on the Contract Drawings shall be provided.

B All sheeting and shoring inclusive of liner plates shall be cut off 2 feet below ground surface and left in place.lump sum prices stipulated in the Bid

C Excavated materials shall be disposed of by the Contractor as described in Section 31 23 00 of the specifications and the cost of which shall be included in the various lump sum prices stipulated in the bid.

3.2 GENERAL MASONRY CONSTRUCTION

A Brick shall be laid regularly and truly to line, with joints not exceeding 1/2 inch in thickness on the face, and with joints completely filled with mortar as each brick is pushed into place, and no subsequent filling of said joints will be allowed except for circular walls.

B The exposed faces of brick masonry shall have all mortar projecting beyond the surface of the brick scraped off and the brick work shall be thoroughly cleaned and the joints pointed immediately after placing. No broken or cut brick will be allowed to be used except where absolutely necessary as closures. Where cuffing of brick is necessary, such faces as are exposed in the same must be accurately trimmed to the contour of the face of the work in which the bricks are laid.

C All brick work shall be bonded as may be directed, and adjoining courses shall break joints one-half a brick as nearly as practicable. Brick work shall be executed straight and vertical, or regularly curved or battered, as shown or specified. Whenever brick masonry is left for the night or is left unfinished for any reason, the masonry surface shall be raked off or toothed as directed, and all mortar removed from the exposed surfaces of the bricks. When new work is joined to work previously laid, the old brick work must first be thoroughly scraped free from adhering mortar or earth and thoroughly washed with water. When new brick work is to be joined to existing brick work, it is to be toothed to provide proper tie of new work to old.

D Backfill and foundation shall conform to specification section 31 23 00 and as shown on drawings.

3.3 PRECAST MANHOLES

A Precast concrete manhole riser sections shall be installed plumb and true on the precast concrete base sections as shown on the Contract Drawing. Before placing the O-ring gasket in the spigot groove, the gasket and all bearing surfaces of the tongue and groove shall be wiped clean, and a lubricant as recommended by the manufacturer shall be applied to the gasket and the inside bell surface. Care shall be taken when lowering any precast unit into the trench that no dirt gets on the gasket or into the joint. Top sections of precast manholes shall be flat slab-type or eccentric cone sections cast to the proper dimensions to receive the manhole casting shown on the Contract Drawings.

B All manhole riser section joints more than 20 feet below the manhole rim shall be provided with an exterior joint collar and be installed according to the manufacturer's recommendations. After removing the protective paper, the band shall be placed around the manhole riser, mastic side to the riser and spanning the joint. The steel straps shall be secured with the proper tools. The closing flap shall cover all remaining exposed strap.

C The top of the wall of all manholes shall be properly leveled off with mortar so as to form a flat surface upon which the manhole rim is to rest, and manholes shall be carried to such height above the sewer as shown, as necessary to meet grade or as ordered, but shall not be left in a depression to act as an area drain.

D When there is not enough room for a full length of precast concrete riser section to be installed under the manhole frame, precast reinforced concrete grade rings and mortar shall be used for sanitary manholes. The use of brick masonry on sanitary manholes is prohibited.

E In order to allow for a future adjustment of roadway grade or widening of existing roadway, shorter lengths of riser sections when used should be installed immediately below the cone section. Also, a minimum of one precast concrete grade ring will be required on top of the cone or flat slab top section to effect the proper elevation for the manhole rim. The total height of precast concrete grade rings and mortar shall not exceed 12 inches.

F Precast bottom sections with integral bases when used shall be set plumb on a firm foundation in the trench. Height of the bottom section shall be provided to admit the various pipes at the elevations shown on the drawings and still contain sufficient material for structural integrity across the top of these openings. Pipe openings shall be cast into the unit at the time of manufacture. All pipe connections to precast concrete manholes shall be made with resilient connectors conforming to ASTM C923.

G Cast-in-place non-reinforced concrete manhole bottom sections shall be built in accordance with the dimensions indicated on the Contract Drawings. Forming and finishing shall be done per Local DOT or city/county agency reference Standard Specifications.

H Manholes shall have steps (rungs) built into the precast and cast-in-place concrete manhole sections and shall be securely embedded in the precast concrete manhole wall at the time of manufacture. Steps shall be placed as shown on the Contract Drawings. The Contractor shall arrange the various components that will become part of the manhole so that the vertical step spacing is consistent and the frame and cover is situated as oriented in plan on the Contract Drawings.

I The manhole frames shall be properly set in place in a full bed of mortar and so adjusted as to make the top of the rim a few inches higher than the surrounding ground so as not to act as a surface drain, or flush with paved surfaces.

3.4 CLEANING

A Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

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SECTION 33 05 45
REINFORCED CONCRETE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A Scope:

1. This section specifies reinforced concrete pipe. This section contains specifications for manholes and appurtenances.

B Pipe Designations:

1. Reinforced concrete pipe designations shall be as follows:

Designation	Definition
RCP	Reinforced Concrete Pipe

C Definitions:

1. Pipe Joint: The area approximately 12 inches each way from the centerline of the visible gap between pipe lengths.
2. Pipe Length: The pipe between two joints; part of a pipe section.
3. Pipe Section: The reach of pipeline between two successive manholes.

1.2 QUALITY ASSURANCE

A References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C76	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
ASTM C139	Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C150	Portland Cement
ASTM C443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM C497	Testing Concrete Pipe, Sections, or Tile

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Reference	Title
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
ASTM E329	Standard Specification for Agencies Engaged in Construction

B Testing:
1. The Contractor shall provide the services of an independent testing laboratory which complies with ASTM E329 and is a member of the American Council of Independent Laboratories.
2. General: The Owner shall be notified of the place and time of testing 1 week prior to the commencement of testing.
3. Concrete Compression Tests: Compression tests shall be as specified in ASTM C76, Section 11.4.1.
4. D-LOAD tests: Pipe shall be tested in accordance with ASTM C76, Section 11.3 and ASTM C497. Loads used for testing shall be the load to produce the 0.01-inch crack or the design test load, whichever is less.
   a. One percent of the total number of pipes, with a minimum of three pipe lengths, of each class, size and wall type shall be tested.

C The following information shall be provided in accordance with Section 01 33 00 - Submittal Procedures.
1. Product data: Submit data for
2. Manufacturer's installation instructions: Submit special procedures required to install products specified
3. Manufacturer's certificate: certify products meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A Pipe:
1. Unless otherwise specified, pipe shall conform to the following specifications:
   a. RCP: ASTM C76, Class III.
2. Cement shall be ASTM C150, Type II.

B Gaskets:
1. Gaskets shall conform to the following specifications:
   a. RCP:ASTM C443, Section 5.

2.2 MANUFACTURE

A Pipe:
1. General: Unless otherwise specified, all pipe used for services other than storm drains shall be manufactured by centrifugally spun or vertically wet cast method. Pipe manufactured by the vertically wet cast method shall be cast with the spigot end down. Reinforcing steel for each length of pipe shall be held in place throughout the casting operation. Lift holes are not acceptable.
2. RCP: Pipe shall be manufactured in conformance with ASTM C76. Joints shall be mortared tongue and groove, unless otherwise specified.

B Rubber Gasket Joints:
1. Joints shall use either concrete bell and spigot.

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C Length and Bevels:

1. Pipe shall be fabricated in nominal lengths of at least 8 feet except where shorter lengths are required to meet special conditions. Pipe ends may be beveled a maximum of 5 degrees to accommodate changes in alignment or curved alignments of the pipeline.

D Where specified, the upper 270 degrees of the interior of reinforced concrete pipe and surfaces of appurtenant structures except inverts, shall be lined. Joints between individual sheets or sections of the lining shall be continuously heat-welded using welding strips of similar type and equivalent thickness of material as the liner. Installation of the lining in concrete pipe and the field sealing and welding of joints shall be done in accordance with the lining manufacturer's instructions.

PART 3 - EXECUTION

3.1 PIPE LAYING

A RCP:

1. Preparation of bedding and backfill shall be as specified in Section 31 23 00 and the drawing details. Pipe shall be laid with uniform bearing under the full length of the barrel of the pipe.
2. The interior of the pipeline shall be cleaned as the work progresses.
3. The line and grade of any one pipe shall not deviate more than that specified in the following table. The allowable deviation is not cumulative.

Pipe length, feet	**Maximum deviation per pipe length, feet**
8	0.06
10	0.09
12	0.11
16	0.14

4. Assembled pipe joints shall be kept in compression until the placement of the initial backfill is complete.

B Jointing:

1. During jointing, neither mortar nor buttering compound is acceptable on either the exterior or interior of the joints. After jointing, joints over 3/4 inch shall be mortared.

3.2 STRUCTURES

A Structures shall be as specified. Openings for future connections shall be sealed with a precast concrete plug made watertight with mastic compound or rubber gaskets. Concrete mortar shaping within any structure shall be as specified in Division 3.

3.3 PIPELINE ACCEPTANCE

A RCP:

1. After backfilling and restoration of surfaces, pipelines shall be cleaned. Pipelines 21 inches or less in diameter shall be cleaned by the sewer ball method unless the pipeline can be shown to be clean by visual inspection.

END OF SECTION

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