PIERI + ASSOCIATES ARCHITECTS

TECHNICAL SPECIFICATIONS MANUAL

Banco Popular

Villalba (De Novo) Ground Up Branch

Project Number: RE002493

100% Construction Documents Set

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SECTION 01 10 00 - SUMMARY OF WORK

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Conditions of the Contract.

B. Owner/Contractor Agreement.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The work scope includes a complete contract interior fit-out as described in the construction drawings, instructions to bidders, and technical specifications for a full remodeling of the Banco Popular Yauco Plaza branch.

B. The scope includes selective interior demolition, interior construction, a new retail storefront with signage, existing potable water cistern and distribution re-installation, and equipment enclosures and platforms required for the 4,168 square foot Banco Popular Yauco Plaza Branch Office Facility. The scope includes, but is not limited to:

1. Interior and selective site demolition. Remove and dispose of all existing floor, partition walls, ceilings, and plenum mounted partition and soffit sub-structures. Remove and dispose of existing ductwork, plumbing fixtures, and plumbing rough-ins, electrical and communications panels, conduits, and light fixtures. LED light fixtures will be stored by contractor and re-installed during construction fitout. Patch, repair, and level existing floor and wall surfaces to receive new finishes and materials.

2. Construct interior within contract limits delineated in the architectural plans. Provide new plumbing rough-ins in existing floor slab, new in-slab and suspended electrical feeder lines, new floor finishes, gypsum board walls and partitions, and 2 hour reinforced gypsum board partition and ceiling at Vault; new finished reinforced concrete wall at Vault storefront wall, aluminum and glass windows, and Owner supplied mantrap entryway system at storefront; acoustic ceiling, soffits, and ceiling mounted HVAC, fire detection and alarm, electrical, lighting, and signal equipment; new plumbing fixtures, valves and accessories; sanitary, vent, potable water distribution, and rainwater drainage and rain leaders.

3. Construct new steel utility enclosure for relocated pad-mounted potable water cistern, pump, and distribution system, and HVAC equipment.

4. VRF type split air conditioning system: with fresh air intakes, ductwork, supply air terminals, and duct, ceiling, and wall mounted return air grilles will be supplied and installed by the contractor. The new air handling units will be connected to the Banco Popular building BAS using BACKNET programming protocol. Contractor will provide Test & Balancing of the system and will participate in the commissioning process as indicated in Division 22, Division 23 and Division 26 specification sections.

5. Auto Banking canopy extension and installation of eight (8) Auto banking teller and client positions below existing and expanded canopy. Canopy extension is a steel superstructure with built-up roofing over coverboard and metal deck, complete with roof drains, scuppers, and leaders. The canopy is supported by two round concrete columns with base and foundation. Concrete auto banking lane islands will be extended to the North and will include new roof rainwater outlet. Provide all underground electrical and signal connections between teller and client stations.

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1.3 CONTRACTS

A. Perform Work under single Contract as designated in Owner-Contractor Agreement.

1.4 WORK BY OTHERS

A. The Owner reserves the right to execute separate contracts for additional work at the site; consult, cooperate, and coordinate with Owner and separate contractors to facilitate execution of their work.

1.5 CONTRACTOR'S USE OF PREMISES

A. Contractor shall limit his use of premises for Work and for storage, to allow for work by separate contractors.

B. Coordinate use of premises under direction of Owner:

1. Coordinate with the Owner and Architect before beginning any work to protect sensitive operational areas adjacent to the contract limits from construction activities and provide physical separation using temporary walls and partitions complying with the requirements outlined in these technical specifications.
2. Store and stage materials in areas approved by Owner. Do not unreasonably encumber site or adjacent areas outside of contract area with stored materials or equipment. Obtain and pay for use of any additional storage or work areas needed for operations.
3. Maintain access to existing adjacent buildings, streets, walks, fire hydrants, and other existing facilities. Coordinate any required street and sidewalk closings with the property manager and project owner.
4. Move any stored products, under Contractor's control that interfere with operations of separate contractors.

C. Assume full responsibility for protection and safe keeping of products under this Contract, stored on or off site.

PART 2 PRODUCTS

Not Used. See plans and technical specifications.

PART 3 EXECUTION

Not Used.

END OF SECTION 01 01 00

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SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.2 SCHEDULE OF VALUES

A. Submit a printed schedule on AIA Form G703 - Application and Certificate for Payment Continuation Sheet. Contractor's standard form or electronic media printout will be considered.

B. Submit Schedule of Values in duplicate within 5 days after date established in Notice to Proceed.

C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization.

D. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application for Payment.

G. The Application for Payment will not be processed if the revised schedule or any required documentation is not submitted with it. The Owner will notify in writing in 2 working days of submittal of the Application for Payment if any required documentation is pending.

1.3 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Present required information in typewritten form.

C. Form: AIA G702 Application and Certificate for Payment and AIA G703 - Continuation Sheet including continuation sheets when required.

D. For each item, provide a column for listing each of the following:

1. Item Number.
2. Description of work.
3. Scheduled Values.
4. Previous Applications.
5. Work in Place and Stored Materials under this Application.
6. Authorized Change Orders.
7. Total Completed and Stored to Date of Application.
8. Percentage of Completion.

9. Balance to Finish.

10. Retainage.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

H. Submit three copies of each Application for Payment.

I. Include the following with the application:

1. Transmittal letter as specified for Submittals in Section 01 33 00.

2. Construction progress schedule revised and current as specified in Section 01 30 00.

3. Current construction photographs specified in Section 01 30 00.

4. Partial release of liens from major Subcontractors and vendors.

5. Project record documents as specified in Section 01 78 00, for review by Owner which will be returned to the Contractor.

6. Affidavits attesting to off-site stored products.

J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.4 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time as authorized by the Conditions of the Contract by issuing supplemental instructions on AIA Form G710.

C. Construction Change Directive: Architect may issue a document, signed by Owner, instructing Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. The document will describe changes in the Work and will designate method of determining any change in Contract Sum or Contract Time.

2. Promptly execute the change in Work.

D. Proposal Request: At the Owner’s request the Project Manager may issue a document which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 5 working days.

E. Computation of Change in Contract Amount:

1. For change requested by Owner for work falling under a fixed price contract, the amount is based on Contractor's price quotation.

2. For change requested by Contractor, the amount is based on the Contractor's request for a Change Order as approved by Owner.
3. For pre-determined unit prices and quantities, the amount is based on the fixed unit prices.
4. For change ordered by Owner without a quotation from Contractor, the amount is determined by Owner based on the Contractor's substantiation of costs as specified for Time and Material work.
5. Substantiation of Costs: Provide full information required for evaluation.

F. On request, provide following data:

1. Quantities of products, labor, and equipment.
2. Taxes, insurance, and bonds.
3. Overhead and profit.
4. Justification for any change in Contract Time.
5. Credit for deletions from Contract, similarly documented.
6. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times when work was performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
7. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: The Owner's assigned representative will issue Change Orders for signatures of parties as provided in the Conditions of the Contract on AIA G701.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.

1.5 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 01 78 00.
2. Submittal of all required tests and certifications as required by the Testing Requirement Document.
3. All documentation and certifications for the transmittal of the building's Use Permit in OGPe ("General Permits Office").

4. Operational and Maintenance Manual, including detailed information on installed materials and finishes, equipment manuals, certifications and warranty information, and evidence that corresponding owner personnel training sessions were carried out.

5. Set of complete as-built Drawings.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 20 00

SECTION 01 25 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications including changes in the work and substitutions to materials, products, assemblies, and equipment.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 01 22 00 "Unit Prices" for administrative requirements governing use of unit prices.

2. Section 01 30 00 "Administrative Requirements" for requirements for the Contractor's Construction Schedule.

1.2 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.

1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.

a. Unavailability.

b. Regulatory changes.

2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 MINOR CHANGES IN THE WORK

A. The Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on AIA Form G710, Architect's Supplemental Instructions.

3.2 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: The Architect will issue a detailed description of proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

B. Proposal requests issued by the Architect are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.

C. Within 10 days of receipt of a proposal request, submit an estimate of cost necessary to execute the change to the Architect for the Owner's review.

D. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

E. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

F. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

G. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Architect.

H. Include a statement outlining the 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 Contract Time.

I. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

J. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

K. Comply with requirements in Section "Product Substitutions" if the proposed change requires substitution of one product or system for a product or system specified.

L. Proposal Request Form: Use AIA Document G709 for Change Order Proposal Requests.

3.3 ALLOWANCES

A. There are no unit-cost allowances in the project scope of work.

3.4 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and the Contractor disagree on the terms of a Proposal Request, the Architect may issue a Construction Change Directive

on AIA Form G714. The Construction Change Directive instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. The Construction Change Directive contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.

C. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

D. After completion of the work stipulated in the Construction Change Directive, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

3.5 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Proposal Request, the Architect will issue a Change Order for signatures of the Owner and the Contractor on AIA Form G701.

3.6 GENERAL SUBSTITUTION PROCEDURE REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
2. Agrees to provide the same warranty for the substitution as for the specified product.
3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
5. Waives claims for additional costs or time extension that may subsequently become apparent.
6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. Substitution Request for specified installer constitutes a representation that the submitter:

1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
2. Has identified a qualified installer that is able to do the work as specified in the contract documents.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

E. Limit each request to a single proposed substitution item.

1. Submit three (3) hard-copies, bound and collated,

2. Submit one (1) electronic copy uploaded to the project management website, or sent directly to the Architect and Owner by e-mail..

3.7 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

B. Submittal Form (before award of contract):

1. Submit substitution requests by completing CSI/CSC Form 1.5C – Substitution Request (During the Bidding/Negotiating Stage). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.8 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):

1. Submit substitution requests by completing CSI/CSC Form 13.1A – Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Architect will consider requests for substitutions only within 15 calendar days after date of Agreement.

C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or other specific ways.

2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.

3. Bear the costs engendered by proposed substitution of:

a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

b. Other unanticipated project considerations.

E. Substitutions will not be considered under one or more of the following circumstances:

1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

2. Without a separate prior written request.

3. When acceptance will require revisions to Contract Documents.

3.9 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.10 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.11 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 01 25 00

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preconstruction meeting.

B. Site mobilization meeting.

C. Progress meetings.

D. Construction progress schedule.

E. Progress photographs.

F. Coordination drawings.

G. Submittals for review, information, and project closeout.

H. Number of copies of submittals.

I. Submittal procedures.

1.2 RELATED SECTIONS

A. Section 01 10 00 - Summary: Stages of the Work, Work covered by contract.

B. Section 01 70 00 - Execution Requirements: Additional coordination requirements.

C. Section 01 78 00 - Closeout Submittals: Project record documents.

D. Section 01 81 00 - Commissioning: Additional procedures for submittals relating to commissioning.

1. All Submittals shall be submitted directly to the Building Inspector, who will submit them to the Architect.

2. Where submittals are indicated for review by both Architect and the Commissioning Authority, submit one extra and route to Architect first, for forwarding to the Commissioning Authority.

3. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Authority; otherwise, the procedures specified in this section apply to commissioning submittals.

1.3 PROJECT COORDINATION

A. Project Coordinator: Owner's Project Manager.

B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for Site access, traffic, and parking facilities.

C. During construction, coordinate use of site and facilities through the Project Coordinator.

D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.

F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

G. Make the following types of submittals to Architect through the Project Coordinator:

H. Requests for interpretation.

I. Requests for substitution.

J. Shop drawings, product data, and samples.

K. Test and inspection reports.

L. Design data.

M. Manufacturer's instructions and field reports.

N. Applications for payment and change order requests.

O. Progress schedules.

P. Coordination drawings.

Q. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 UNIT PRICES

A. Definitions

1. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if the estimated quantities of Work required by the Contract Documents are increased or decreased.

2. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; insurance, overhead, and profit.

3. Quantities indicated in the Bid Form are for bidding and contract purposes only. Actual Work Quantities and measurements will determine the payment amount.

B. Measurement of Quantities

1. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

2. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.

3. Assist by providing necessary equipment, workers, and survey personnel as required.

C. Measurement Devices:

1. Weight Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.
4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
6. Measurement by Area: Measured by square dimension using mean length and width or radius.
7. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
9. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

D. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes, calculate and certify quantities for payment purposes.

E. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this work measured, at the Owner's expense, by an independent surveyor acceptable to the Contractor.

F. Payment

1. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work which is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit sum/price.
2. Payment will not be made for any of the following:
3. Products wasted or disposed of in a manner that is not acceptable.
4. Products determined as unacceptable before or after placement.
5. Products not completely unloaded from the transporting vehicle to an acceptable on-site storage or staging area.
6. Products placed beyond the lines and levels of the required Work.

7. Products remaining on hand after completion of the Work, unless Product is specifically identified as attic stock by Owner in the Specification
8. Loading, hauling, and disposing of rejected Products.

G. Defect Assessment

1. Replace Work, or portions of the Work, not conforming to specified requirements.
2. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
3. The defective Work will be partially repaired to the instructions of the Architect, and the unit sum/price will be adjusted to a new sum/price at the discretion of Architect.
4. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
5. The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of Owner.
6. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.
7. The authority of Owner to assess the defect and identify payment adjustment is final.

H. Schedule Of Unit Prices

1. Submit Schedule of Unit Prices for labor, materials and equipment in duplicate within 15 days after date established in Notice to Proceed.

3.2 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:

1. Owner.
2. Architect.
3. Contractor.
4. Sub-Contractors.
5. Consulting Engineers

C. Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract, Owner, Contractor and Architect.

6. Procedures and processing of field decisions, submittals and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.

7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.3 SITE MOBILIZATION MEETING

A. Owner will schedule a meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:

1. Contractor.

2. Owner.

3. Architect.

4. Special Consultants.

5. Contractor's Superintendent.

6. Major Subcontractors.

C. Agenda:

1. Use of premises by Contractor.

2. Survey and building layout.

3. Security and housekeeping procedures.

4. Schedules.

5. Application for payment procedures.

6. Procedures for testing.

7. Procedures for maintaining record documents.

8. Requirements for start-up of equipment.

9. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.4 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly intervals.

B. Architect will plan meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Contractor's project manager, job superintendent, major Subcontractors and suppliers, Owner, Architect. Attendance by others as appropriate to agenda topics for each meeting.

D. Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.5 CONSTRUCTION PROGRESS SCHEDULE

A. Within 5 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. Within 5 days after review of preliminary schedule, submit proposed complete schedule for review.

1. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.

C. Within 5 days after joint review, submit complete schedule.

D. Submit updated schedule with each Application for Payment.

3.6 PROGRESS PHOTOGRAPHS

A. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Owner.

B. Take photographs at the end of each month and as follows:

1. Site clearing.
2. Excavations.
3. Foundations.
4. Structural framing.
5. Enclosure of building.

6. Interior Fit-out
7. MEP systems installation
8. Final completion.

C. Views:

1. Provide aerial photographs from east and west views at each specified time, until structure is enclosed.
2. Consult with Owner for instructions on any additional views required.
3. Provide factual presentation.
4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

D. Prints: Full color; three prints of each view.

1. Matte; smooth texture; white tint; single weight; contrast grade 4, extra hard.
2. Size: 8 x 10 inch (200 x 250 mm); mounted for binder and tabs.
3. Identify each print on front. Identify name of Project, contract number, phase, orientation of view, date and time of view, Provide name and address of photographer, and photographer's numbered identification of exposure on back.

E. Deliver prints with each Application for Payment with transmittal letter specified in this Section.

3.7 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Review drawings prior to submission to Architect.

3.8 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:

1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.
5. Certificates.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with article 3.11 below and for record documents purposes described in Section 01 78 00 - CLOSEOUT SUBMITTALS.

3.9 SUBMITTALS

A. When the following are specified in individual sections, submit them for information:

1. Design data.
2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's and owner's knowledge and approval.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:

1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review:

1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit 6 copies which the Owner requires, plus 1 which will be retained by the Architect.
2. Larger Sheets, Not Larger Than 24 x 36 inches (600 x 900 mm): Submit the number of opaque reproductions which Contractor requires, plus one copy which will be retained by Architect.

B. Documents for Information: Submit two copies.

C. Documents for Project Closeout: Make 3 reproductions of submittal originally reviewed. Submit 3 extra of submittals for information.

D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. Transmit each submittal with approved form.

B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier, pertinent drawing and detail number, and specification section number, as appropriate on each copy.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

E. Deliver submittals to Owner at business address. Submittals may also be distributed during weekly project progress meetings.

F. Schedule submittals to expedite the Project, and coordinate submission of related items. Submittals shall be received by the Architect at least 28 calendar days before the work is to be carried out. If the work is related to equipment or materials that have a lead time, the corresponding submittal shall be received at least 56 days before the Contractor has to place the order. The contractor has the responsibility to avoid delays in the Work resulting from tardy submission of Submittals.

G. For each submittal for review, allow 10 days excluding delivery time to and from the Contractor.

H. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

I. Provide space for Contractor and Architect review stamps.

J. When revised for resubmission, identify all changes made since previous submission.

K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

END OF SECTION 01 30 00

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY:

A. Related Sections:

1. Section 01 50 00 - Temporary Facilities and Controls.
2. Section 01 60 0 – Product Requirements.
3. Section 01 70 00 – Execution Requirements.
4. Section 01 73 29 - Cutting and Patching.
5. Section 02 41 13 – Selective Site Demolition.

PART 2 PRODUCTS

2.1 MATERIALS

A. New Materials: As specified in individual specification sections; match existing materials for patching and extending work.

B. Type and Quality of Existing Materials: Refer to existing as a minimum product standard.

PART 3 EXECUTION

3.1 PREPARATION

A. Cut, move or remove items as necessary for access to alterations and renovation work. Replace and restore upon completion.

B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated concrete and masonry.

C. Remove debris and abandoned items from areas of work and from concealed spaces.

D. Prepare areas and surfaces to receive new work and finishes.

3.2 INSTALLATION

A. Coordinate work of alterations and renovations to expedite completion.

B. Remove, cut and patch work in manner to minimize damage and to provide means for restoring products and finishes to their original or specified new condition.

C. Refinish visible existing surfaces in various areas or spaces to specified condition, with neat transition to adjacent surfaces.

D. Install products and finish surfaces as specified in individual sections.

E. Finish patches to provide uniform color and texture over entire surface. If finish cannot be matched, refinish entire surface to nearest intersections.

F. Transitions:

1. Where new work abuts or aligns with existing, provide smooth and even transition. If smooth transition is not possible, terminate existing surface along straight line at natural point of division and make recommendation to Architect for transition.

2. Where a change in plane of 1/4 inch or more occurs, submit recommendation to Architect for transition.

G. Adjustments:

1. Where alterations expose mechanical and electrical components, which were previously concealed, renovate to be concealed in completed work.

2. In addition to specified replacement of equipment and fixtures, restore mechanical and electrical systems to full operational condition.

3. Repair or replace existing surfaces adjacent to new work which are damaged, lifted, discolored, or otherwise imperfect.

END OF SECTION 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance submittals.

B. Mock-ups.

C. Control of installation.

D. Tolerances.

E. Inspection services.

F. Manufacturers' field services.

1.2 RELATED SECTIONS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures.

B. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.3 REFERENCES

A. SECTION 110 of the International Building Code (IBC 2018).

B. ASTM C 1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants.

C. ASTM C 1077-17 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

D. ASTM D 3740-12 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

E. ASTM E 329-18 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

F. ASTM E 543-15 - Standard Practice for Agencies Performing Nondestructive Testing; .

1.4 SUBMITTALS

A. Testing Agency Qualifications:

1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.

2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

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B. Design Data: Submit for Architect's knowledge as contract administrator or for the Owner, for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.

1. Include:

a. Date issued.

b. Project title and number.

c. Name of inspector.

d. Date and time of sampling or inspection.

e. Identification of product and specifications section.

f. Location in the Project.

g. Type of test/inspection.

h. Date of test/inspection.

i. Results of test/inspection.

j. Conformance with Contract Documents.

k. When requested by Architect, provide interpretation of results.

2. Test reports are submitted for Architect's knowledge as contract administrator or for the Owner, for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

2. Certificates may be recent or previous test results on material or product but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.

1. Submit information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

G. Erection Drawings: Submit drawings to Architect and Owner.

1. Submit information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

2. Data indicating incomplete, inappropriate, or unacceptable Work may be subject to action by Architect or Owner.

1.5 TESTING AND INSPECTION AGENCIES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.

B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

D. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

E. Contractor Employed Agency:

1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.

2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.

3. Laboratory: Authorized and licensed to operate in Puerto Rico.

4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.

5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 INSTALLATION CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in the sequence.

C. Request clarification from Architect before proceeding with the work if manufacturers' instructions conflict with those found in the Contract Documents.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work with persons qualified to produce required and specified level of quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 MOCK-UPS

A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be a comparison standard for the remaining Work.

D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

3.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Request clarification from Architect before proceeding with the work if manufacturers' tolerances conflict with those found in the Contract Documents.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.4 TESTING AND INSPECTION

A. Testing Agency Duties:

1. Test samples of mixes submitted by Contractor.

2. Provide qualified personnel on site. Cooperate with Architect and Contractor in performance of services.

3. Perform specified sampling and testing of products in accordance with specified standards.

4. Determine compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.

6. Perform additional tests and inspections required by Architect.

7. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

2. Agency may not approve or accept any portion of the Work.

3. Agency may not assume any duties of Contractor.

4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:

1. Deliver samples to the agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.

2. Cooperate with laboratory personnel and provide access to the Work.

3. Provide incidental labor and facilities:

a. To provide access to Work to be tested/inspected.

b. To obtain and handle samples at the site or at source of Products to be tested/inspected.

c. To facilitate tests/inspections.

d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.

5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.5 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions,

conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Owner 30 days in advance of required observations.

1. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.6 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 40 00

SECTION 01 50 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.

B. Temporary utilities include, but are not limited to, the following:

1. Temporary electric power and light.
2. Ventilation.
3. Sanitary facilities, including drinking water.
4. Storm and sanitary sewer.

C. Support facilities include, but are not limited to, the following:

1. Field offices and storage sheds.
2. Temporary enclosures.
3. Temporary project identification signs and bulletin boards.
4. Waste disposal services.
5. Rodent and pest control.
6. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities include, but are not limited to, the following:

1. Temporary fire protection.
2. Barricades, warning signs, and lights.
3. Sidewalk bridge or enclosure fence for the site.
4. Environmental protection.

1.3 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within 15 days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department, and rescue squad rules.
5. Environmental protection regulations.

B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. If acceptable to the Architect, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

1. Construct temporary partitions and barriers per requirements found in 01 81 19 “Indoor Air Quality Requirements”.

2.2 EQUIPMENT

A. General: Provide new equipment. If acceptable to the Architect, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4-inch, heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 120/208-Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior grade fixtures in areas exposed to moisture.

F. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

G. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

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3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where a given company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.

1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect. Neither the Owner nor Architect will accept cost or use charges as a basis of claims for Change Orders.

B. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

1. Install electric power service underground, except where overhead service must be used.

2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

C. Temporary Lighting: When overhead floor or roof deck has been installed, provide temporary lighting with local switching.

D. Temporary Ventilation: per requirements found in 01 81 19 “Indoor Air Quality Requirements”.

E. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies is not permitted.

1. Provide separate facilities for male and female personnel.

F. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.

1. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

G. Drinking-Water Facilities: Provide containerized, tap-dispenser, bottled-water drinking-water units, including paper supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 55 deg F.

H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordi-

nate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

I. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.

1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.

2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

K. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

L. Collection and Disposal of Waste:

1. Collect waste from construction areas and elsewhere daily. Comply with Section 01 74 19 “Construction Waste Management” and the requirements of NFPA 241 for removal of combustible waste material and debris.

2. Strictly enforce requirements. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

M. Rodent and Pest Control: Before foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

N. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Architect.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

E. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

F. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.4 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion.

D. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the 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 the Contractor's property. The Owner reserves the right to take possession of project identification signs.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area.

3. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns.

4. Repair or replace street paving, curbs, and sidewalks at the temporary entrances, as required by the governing authority.

5. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:

a. Replace air filters and clean inside of ductwork and housings per Section 01 81 19 “Indoor Air Quality Management”.

b. Replace significantly worn parts and parts subject to unusual operating conditions.

c. Replace lamps burned out or noticeably dimmed by hours of use.

d. COORDINATE WITH OTHER SECTIONS IN Division 01.

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations and procedures.

E. Procedures for Owner-supplied products.

F. Spare parts and maintenance materials.

1.2 RELATED SECTIONS

A. Section 01 10 00 – "Summary of Work": Lists of products to be removed from existing building.

B. Section 01 30 00 – "Administrative Requirements" for product submittal and substitution procedures.

C. Section 01 40 00 – "Quality Requirements": Product quality monitoring.

D. Section 01 70 00 – "Quality Requirements": Product and equipment installation procedures.

E. Section 01 81 16 – "VOC Limits for Adhesives, Sealants, Paints, and Coatings".

F. Section 01 81 19 – "Indoor Air Quality Requirements": Materials and methods for acceptable indoor air quality during construction.

1.3 REFERENCES

A. 16 CFR 260 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; current edition.

B. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit http://www.fsccanada.org, for the USA visit http://www.fscus.org.

C. CAN/CSA Z809 - National Standard for Sustainable Forest Management; CSA International Inc.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.4 SUBMITTALS

A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

1. Submit within 15 days after date of Agreement.

2. For products specified only by reference standards, list applicable reference standards.

B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.1 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. Do not use products having any of the following characteristics:

1. Made outside the United States, its territories, Canada, or Mexico.

2. Made using or containing CFC's or HCFC's.

3. Made of wood from newly cut old growth timber.

C. Where all other criteria are met, Contractor shall give preference to products that:

1. Are extracted, harvested, and/or manufactured closer to the location of the project.

2. Have longer documented life span under normal use.

3. Results in less construction waste.

4. Are made of vegetable materials that are rapidly renewable.

D. Products with Recycled Content:

1. Specific Product Categories: Provide recycled content as specified elsewhere.

2. Calculations: Where information about recycled content is required to be submitted:

a. Determine percentage of post-consumer and post-industrial content separately, using the guidelines contained in 16 CFR 260.7(e).

b. Previously used, reused, refurbished, and salvaged products are not considered recycled.

c. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.

d. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of all material in the item.

e. Determine the value of recycled content of each item separately, by multiplying the content percentage by the value of the item.

E. Sustainably Harvested Wood:

1. Definition: Wood-based materials include but are not limited to structural framing, dimension lumber, flooring, wood doors, finishes, and furnishings that are permanently installed in the project. Wood and wood-based products not permanently installed in the project are not included in the definition.

2. Specific Wood-Based Fabrications: Fabricate of sustainably harvested wood when so specified elsewhere.

3. Certification: Provide wood certified or labeled by an organization accredited by one of the following:

a. American Forest Foundation, The American Tree Farm System; refer to http://www.treefarmsystem.org.

b. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit http://www.fsccanada.org, for the USA visit http://www.fscus.org.

c. Sustainable Forestry Board, under The Sustainable Forestry Initiative® of the American Forest & Paper Association; refer to http://www.afandpa.org.

F. Urea-Formaldehyde Prohibition:

1. Overall Project Requirement: Provide composite wood and agrifiber products having no added urea-formaldehyde resins.

a. Require each installer to certify compliance and submit product data showing product content.

2. Specific Product Categories: Comply with limitations specified elsewhere.

G. Adhesives and Joint Sealants:

1. Definition: This provision applies to gunnable, trowelable, and liquid-applied adhesives, sealants, and sealant primers used anywhere on the interior of the building inside the weather barrier, including duct sealers.

2. Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

    a. Require each installer to certify compliance and submit product data showing product content.

3. Specific Product Categories: Comply with limitations specified elsewhere.

H. Aerosol Adhesives:

1. Provide only products having lower volatile organic compound (VOC) content than required by Green Seal GS-36.

    a. Require each installer to certify compliance and submit product data showing product content.

2. Specific Product Categories: Comply with limitations specified elsewhere.

I. Provide interchangeable components of the same manufacture for components being replaced.

J. Motors: Refer to Section 15065 (22 0513), NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

K. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

L. Cord and Plug: Provide minimum 6-foot (2 m) cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.2 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.3 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 OWNER-SUPPLIED PRODUCTS

A. See Section 01 10 00 - Summary for identification of Owner-supplied products.

B. Owner's Responsibilities:

1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:

1. Review Owner reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.2 TRANSPORTATION AND HANDLING

A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

F. Return packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 60 00

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Starting and adjusting.
6. Owner-Installed Products
7. Protection of installed construction.
8. Correction of the Work.

1.3 SUBMITTALS

A. Qualification Data: For land surveyor professional engineer 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.

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

C. Landfill Receipts: Submit copy of receipts issued by landfill and materials recycling facilities to document legal disposal and proper recycling of materials.

D. Certified Surveys: Submit two (2) copies signed by land surveyor professional engineer.

E. Final Property Survey: Submit ten (10) copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS - Not Used

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Utilities: 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 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; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Acceptance of Conditions: 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.

b. List of detrimental conditions, including substrates.

c. List of unacceptable installation tolerances.

d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and 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.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

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1. Notify Architect and Owner not less than three (3) days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's and Owner's written permission.

C. 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.

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

E. Review of Contract Documents and Field Conditions: Submit a request for information to Architect immediately on discovery of the need for clarification of the Contract Documents. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests using "Request for Information" form supplied by Architect.

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 Architect promptly.

B. General: Engage a professional engineer 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

6. 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 invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. 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.

B. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of **8 feet** in spaces without a suspended ceiling.

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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels or excessive emissions.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

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.

G. 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.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

2. Pre-installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: 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 materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F with a relative humidity level over 65%.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Keep containers closed when not in use. Mark containers appropriately and dispose of legally, according to regulations.

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

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution or delivery of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

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

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

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

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.

3.8 EQUIPMENT START-UP AND ADJUSTING

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

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

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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes per Section 01 73 29 “Cutting and Patching”.

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.

F. Remove over painting on all exposed material surfaces and components.

G. Clean and remove fingerprints and smudges from all exposed material surfaces and light fixture reflectors.

3.11 FINAL CLEANING

A. Employ experienced personnel, or professional cleaning firm for final cleaning.

B. Materials

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

2. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

3. Provide proper containers for storing and transporting waste.

4. Provide proper equipment for specific cleaning functions.

C. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from visible interior and exterior finish surfaces; polish surfaces so designated to shine finish.

D. Broom clean paved surfaces; rake clean other surfaces of grounds.

E. Clean glass, glazing, and surrounding window or door frame on interior and exterior surfaces.

F. Remove overpaint from all visible surfaces.

G. Ventilating and Air Conditioning System:

1. Replace air conditioning filters.

2. Clean ducts, blowers and coils.

H. Wipe down and remove all fingerprint smudges and dirt from lighting fixture reflector surface and trims

I. Maintain cleaning until project, or portion thereof, is accepted by Owner.

J. At completion of Work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials and clean sight-exposed surfaces; leave project clean and ready for occupancy.

END OF SECTION 01 70 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 GENERAL

1.1 DESCRIPTION:

A. Execute cutting to include excavating, fitting or patching of Work required to:

1. Make several parts fit properly.
2. Match and provide a smooth, even transition between new and existing finishes.
3. Interface new and existing work.
4. Uncover work to provide for installation of ill-timed work.
5. Remove and replace defective work.
6. Remove and replace work not conforming to requirements of Contract Documents.
7. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

1.2 SUBMITTALS

A. Submit written request well in advance of executing cutting or alteration that affects:

1. Structural integrity of project.
2. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
3. Efficiency, operational life, maintenance or safety of operational elements.
4. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of project.
2. Description of work affected.
3. Necessity for cutting or patching.
4. Effect of cutting or patching on structural, weatherproof or visual integrity of project.
5. Description of proposed work:
    a. Scope of cutting and patching.
    b. Contractor and trades to execute work.
    c. Products proposed to be used.
    d. Extent of refinishing.

6. Alternate to cutting and patching.

7. Cost proposal, if applicable.

C. If conditions of work or schedule necessitate a change of material from that originally installed, submit a written request in accordance with Section 01 35 16.

D. Submit written notice to Architect designating time when the work will be uncovered, to provide for observation.

PART 2 PRODUCTS

2.1 MATERIALS

A. For replacement of work removed, comply with specifications for type of work to be done.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of work, including elements subject to movement or damage during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of new products or performance of work.

3.2 PREPARATION

A. Prior to Cutting:

1. Provide shoring, bracing and support as required to maintain structural integrity of project.

2. Provide protection for other portions of project.

3. Provide protection from elements.

3.3 PERFORMANCE

A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, and finishes.

B. Execute cutting and demolition by methods that will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.

C. Execute excavating and backfilling by methods which will prevent damage to other Work and will prevent settlement.

D. Employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

E. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.

F. Refinish entire surfaces as necessary to provide an even finish:

1. Continuous surfaces: To nearest intersections.

2. Assembly: Refinish entirely.

END OF SECTION 01 73 29

SECTION 01 74 19 - WASTE MANAGEMENT

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 01 10 00 – "Summary": List of items to be salvaged from the existing building for relocation in project or for Owner.

B. Section 01 30 00 – "Administrative Requirements": Additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. Section 01 50 00 – "Temporary Facilities and Controls": Additional requirements related to trash/waste collection and removal facilities and services.

D. Section 01 60 00 – "Product Requirements": Waste prevention requirements related to delivery, storage, and handling.

E. Section 01 70 00 – "Execution Requirements": Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.2 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically include building materials, packaging, trash, debris, and rubble generated by construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse construction waste material in some manner on the project site.

K. Salvage: To remove waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.3 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.

E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:

1. Aluminum and plastic beverage containers.
2. Corrugated cardboard.
3. Wood pallets.
4. Clean dimensional wood: May be used as blocking or furring.
5. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
7. Paint.
8. Windows, doors, and door hardware.
9. Plumbing fixtures.
10. Mechanical and electrical equipment.
11. Fluorescent lamps (light bulbs).

F. The project landfill diversion goal is at least **85 percent**, by volume or equivalent weight of potential landfill trash/waste by recycling and/or reuse.

G. The following recycling incentive programs are mandatory for this project; Contractor is responsible for implementation:

1. All revenue or savings from construction waste recycling shall accrue to Contractor.

H. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues.

I. The contractor shall develop and follow a Waste Management Plan designed to implement these requirements and present it to the Owner within 10 business days after receipt of Notice of Award of Bid.

J. The following sources may be useful in developing the Waste Management Plan:

1. State Recycling Department, at www.ads.pr.gov.

K. Methods of trash/waste disposal that are not acceptable are:

1. Burning on the project site.

2. Burying on the project site.

3. Dumping or burying on the project contract area, or other property, public or private.

4. Other illegal dumping or burying.

5. Incineration, either on or off-site.

L. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.4 SUBMITTALS

A. See Section 01 30 00 – "Administrative Requirements", for submittal procedures.

B. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.

1. Submit to Owner for review and approval.

2. If Owner wishes to implement any cost alternatives, the Contract Sum will be adjusted as specified elsewhere.

3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.

4. Describe as many alternatives to landfilling as possible:

a. List each material proposed to be salvaged, reused, or recycled.

b. List the proposed local market for each material.

5. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.

6. Provide alternatives to landfilling for at least the following materials:

a. Aluminum and plastic beverage containers.

b. Corrugated cardboard.

c. Wood pallets.

d. Clean dimensional wood.

e. Land clearing debris, including brush, branches, logs, and stumps.

f. Concrete building elements, paving, curbs, sidewalks, low walls and utility boxes.

g. Concrete overpour.

h. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

i. Glass.

j. Gypsum drywall and plaster.

k. Paint.

l. Plastic sheeting.

m. Rigid foam insulation.

n. Windows, doors, and door hardware.

o. Plumbing fixtures.

p. Mechanical and electrical equipment.

q. Fluorescent lamps (light bulbs).

C. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.

D. Waste Management Plan: Include the following information:

1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.

2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).

3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.

   a. List each material proposed to be salvaged, reused, or recycled.

   b. List the local market for each material.

   c. State the estimated net cost, versus landfill disposal.

4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.

5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.

6. Transportation: Identify the destination and means of transportation of materials to be recycled, i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.

1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.

2. Landfill Disposal: Include the following information:

   a. Identification of material.

   b. Amount, in tons and equivalent cubic yards, of trash/waste material from the project disposed of in landfills.

   c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.

   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

3. Recycled and Salvaged Materials: Include the following information for each:

   a. Identification of material, including those retrieved by installer for use on other projects.

   b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.

c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.

d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

e. Certification by receiving party that material will not be disposed of in landfills or by incineration.

4. Material Reused on Project: Include the following information for each:

a. Identification of material and how it was used in the project.

b. Amount, in tons or cubic yards.

c. Include weight tickets as evidence of quantity.

5. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

F. Recycling Incentive Programs:

1. Where revenue accrues to Contractor, submit copies of documentation required to qualify for incentive.

2. Where revenue accrues to Owner, submit any additional documentation required by Owner in addition to information provided in periodic Waste Disposal Report.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing implementation and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, the Owner, and Architect.

C. Instruction: Provide on-site instruction to all personnel on appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.

1. Pre-bid meeting.

2. Pre-construction meeting.

3. Regular job-site meetings.

4. Job safety meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.

1. As a minimum, provide:

a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.

b. Separate dumpsters for each category of recyclable.

c. Recycling bins at worker lunch area.

2. Provide containers as required.

3. Use signage to clearly identify intended container contents.

4. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.

5. Provide materials for barriers and enclosures that are non-hazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.

6. Locate enclosures out of the way of construction traffic.

7. Provide adequate space for pick-up and delivery and convenience to subcontractors.

8. If an enclosed area is not provided, clearly lay-out and label a specific area on-site.

9. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

3.2 Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 74 20

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.2 RELATED SECTIONS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution Requirements: Contract closeout procedures.

C. Section 01 78 23 – Operations and Maintenance Data.

D. Section 01 79 00 – Demonstration and Training

E. Section 01 91 13 – General Commissioning Requirements.

F. Individual Product Sections: Specific requirements for operation and maintenance data.

G. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.

2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.

3. Submit 1 copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.

4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.

2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.

2. Specifications.

3. Addenda.

4. Change Orders and other modifications to the Contract.

5. Reviewed shop drawings, product data, and samples.

6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured depths of foundations in relation to finish first floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

4. Field changes of dimension and detail.

5. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.

2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:

1. Description of unit or system, and component parts.

2. Identify function, normal operating characteristics, and limiting conditions.

3. Include performance curves, with engineering data and tests.

4. Complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

C. Include color coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

O. Additional Requirements: As specified in individual product specification sections.

3.5 OPERATION AND MAINTENANCE MANUALS

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

B. Prepare data in the form of an instructional manual. All file sections of the manual and the bound formatted manual file will be presented to the Architect in PDF format on a clean and formatted USB drive. Minimum file resolution is 300 dpi.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

D. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

E. Text: Manufacturer's data in PDF format. Scanned documents are permitted but must be formatted in PDF with recognizable text and 300 dpi resolution.

F. Drawings: Large format drawings formatted in PDF with recognizable text and 300 dpi resolution.

G. Arrange content by systems under CSI Division section numbers and sequence of Table of Contents of this Project Manual.

H. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

   a. Significant design criteria.

   b. List of equipment.

   c. Parts list for each component.

   d. Operating instructions.

   e. Maintenance and preventative maintenance instructions for equipment and systems.

   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:

   a. Shop drawings and product data.

I. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

J. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.6 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include copies of each in operation and maintenance manuals, indexed separately on Table of Contents. Original hard copy warrantees are submitted along with the operation and maintenance manual electronic file

END OF SECTION 01 78 00

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. 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,

B. including the following:

1. Maintenance of As-Built Drawings
2. Record Drawings.
3. Record Specifications.
4. Record Product Data.
5. Miscellaneous record submittals.

C. Related Sections:

1. Section 01 70 00 "Execution Requirements" for final property survey.
2. Section 01 78 00 "Closeout Submittals" for general closeout procedures and operation and maintenance manual requirements.
3. Each Section in Divisions 02 through 49 for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance of As-Built Drawings

1. The Contractor shall keep a careful record set of working as-built drawings at the job site, marked in red, of all changes and corrections from the contract drawings. Enter changes and corrections on drawings promptly to reflect "Current Construction". The update shall be done no less frequently than on a weekly basis for the blue line drawings and update no less frequently than a quarterly basis for the CAD files. Include confirmation that the as-built drawings are up to date with the submission of the monthly project schedule.
2. The Contracting Officer will deduct from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the as-built drawings if the Contractor fails to maintain the as-built drawings as required herein.
3. Final payment with respect to separately priced facilities or the contract as a whole will be withheld until proper as-built drawings have been furnished to and approved by the Contracting Officer.

4. Retainage for the final as-built drawings in the amount of $50,000, or 1%, of the present construction value, whichever is greater, shall be withheld until the final as-built drawing submittal has been approved by the Owner.

5. The marked-up set of drawings shall reflect any changes, alterations, adjustments or modifications. Changes must be reflected on all sheets affected by the change. Changes shall include marking the drawings to reflect structural details, foundation layouts, equipment sizes, and other extensions of design.

6. Both paper and electronic documents shall be available at all times and shall be provided promptly to the Contracting Officer when requested.

7. The Contractor is responsible for backup of electronic files during construction and for controlling release of information.

8. Typically, room numbers shown on the contract drawings are selected for design convenience and do not represent the actual numbers intended for use by the end user. Final as-built drawings shall reflect actual room numbers adopted by the end user.

    a. Computer Aided Design and Drafting (CAD) Drawings. Only personnel proficient in the preparation of CAD drawings shall be employed to prepare and modify the construction drawings or prepare additional new drawings.

    b. Additions and corrections to the construction drawings shall be equal in quality to that of the originals. Line work, line weights, lettering, layering conventions, and symbols shall be the same as the original line work, line weights, lettering, layering conventions, and symbols.

    c. Prepare additional drawings required using the specified electronic file format applying the same guidance specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings.

    d. Additions and corrections to the contract drawings shall be accomplished using CADD media files supplied by the Designers of Record. All work by the Contractor shall be done on files in the format in which they are provided. Translation of files to a different format, for the purpose of As-Built production, and then retranslating back to the format originally provided, will not be acceptable.

    e. The Contractor is responsible for providing all program files and hardware necessary to prepare final as-built drawings. The Contracting Officer will review final as-built drawings for accuracy and the Contractor shall make all required corrections, changes, additions, and deletions.

    f. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked in the bottom right-hand corner of each drawing either "AS-BUILT" drawing denoting no revisions on the sheet, or

"REVISED AS-BUILT" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

B. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal: Submit one paper copy set and PDF electronic files of mark-up record prints and one set(s) of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

3. Final Submittal: Submit one paper copy set and PDF electronic files of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.

a. Final Submittal: Submit one paper copy set and PDF electronic files of marked-up record prints, one set(s) of record digital data files, and three set(s) of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.

C. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

D. Record Product Data: Submit annotated PDF electronic files and directories of each submittal. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

E. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

F. Reports: Submit written report indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, 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.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an acceptable drawing technique.

c. Record data as soon as possible after obtaining it.

d. Record and check the markup before enclosing concealed installations.

e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Depths of foundations below first floor.

d. Locations and depths of underground utilities.

e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.

g. Actual equipment locations.

h. Duct size and routing.

i. Locations of concealed internal utilities.

j. Changes made by Change Order or Construction Change Directive.

k. Changes made following Architect's written orders.

l. Details not on the original Contract Drawings.

m. Field records for variable and concealed conditions.

n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: DWG, Version AutoCAD, operating in Microsoft Windows operating system.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Architect for resolution.
6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
    a. Refer to Section 01 30 00 "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 PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
    a. Project name.

b. Date.

c. Designation "PROJECT RECORD DRAWINGS."

d. Name of Architect.

e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give 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 annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the 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. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss.

C. Provide access to project record documents for Architect's reference during normal working hours. Do not use project record documents for construction purposes.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:

1. All software-operated systems.
2. HVAC systems and equipment.
3. Plumbing equipment.
4. Electrical systems and equipment.
5. Programmable lighting controls and equipment
6. Conveying systems.
7. Landscape irrigation.
8. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:

1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
2. Finishes, including flooring, wall finishes, ceiling finishes.
3. Fixtures and fittings.

1.2 RELATED SECTIONS

A. Section 01 30 00 – “Administrative Requirements”.

B. Section 01 78 00 – “Closeout Submittals”: Operation and maintenance manuals.

C. Division 22 – Specification Sections requiring installed systems commissioning.

D. Division 23 – Specification Sections requiring installed systems commissioning.

E. Division 26 – Specification Sections requiring installed systems commissioning.

1.3 SUBMITTALS

A. See Section 01 30 00 – “Administrative Requirements”, for submittal procedures; except:

1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Architect.
2. Submit one copy to the Architect and one copy to the Owner, not to be returned.

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3. Make commissioning submittals on time schedule specified in the Division 22 – 26 specification sections.

B. Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.

1. Submit to Architect and Owner for review and inclusion in overall training plan.
2. Submit not less than four weeks prior to start of training.
3. Revise and resubmit until acceptable.
4. Provide an overall schedule showing all training sessions.
5. Include at least the following for each training session:
    a. Identification, date, time, and duration.
    b. Description of products and/or systems to be covered.
    c. Name of firm and person conducting training; include qualifications.
    d. Intended audience, such as job description.
    e. Objectives of training and suggested methods of ensuring adequate training.
    f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    g. Media to be used such a slide presentation, hand-outs, etc.
    h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide a training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.
2. Include hand-out copies of all slide presentations, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:

1. Identification of each training session, date, time, and duration.
2. Sign-in sheet showing names and job titles of attendees.
3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

4. Include Architect's formal written acceptance of training session.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.

2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless additional Owner's personnel training are specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Architect.

D. The Architect is responsible for determining that the training was satisfactorily completed and will provide approval forms.

E. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

F. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.

2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.

3. Typical uses of the O&M manuals.

G. Product- and System-Specific Training:

1. Review the applicable O&M manuals.

2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.

3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.

4. Provide hands-on training on all operational modes possible and preventive maintenance.

5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.

6. Discuss common troubleshooting problems and solutions.

7. Discuss any peculiarities of equipment installation or operation.

8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.

9. Review recommended tools and spare parts inventory suggestions of manufacturers.

10. Review spare parts and tools required to be furnished by Contractor.

11. Review spare parts suppliers and sources and procurement procedures.

H. Be prepared to answer questions raised by training attendees; if unable to answer during the training session, provide a written response within three days.

END OF SECTION 01 79 00

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 01 81 16 - VOC LIMITS FOR ADHESIVES, SEALANTS, PAINTS, AND COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for volatile organic compound (VOC) limits for adhesives sealants, paints and coatings used for the Project.

B. Related Sections:

1. Section 01 81 19 – “Indoor Air Quality Requirements”

1.2 REFERENCE STANDARDS

A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation or suggestion occurs in the referenced standards, such recommendation or suggestion shall be considered mandatory. In the event of conflict of referenced standards and this specification or within the standards themselves, the more stringent standard or requirement shall govern.

1. Rule 1168 - "Adhesive and Sealant Applications", South Coast Air Quality Management District (SCAQMD), State of California http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1168.pdf

2. Rule 1113 - "Architectural Coatings": South Coast Air Quality Management District (SCAQMD), State of California http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf

3. Green Seal Paint Standard GS-11, Green Seal, Inc., Washington, DC. http://www.greenseal.org/Portals/0/Documents/Standards/GS-11/GS-11_Ed3-2_Paints_Coatings_Stains_and_Sealers.pdf

4. Green Seal Commercial Adhesive Standard GS-36, Green Seal, Inc., Washington, DC http://www.greenseal.org/Portals/0/Documents/Standards/GS-36/GS-36Ed2-1_Adhesives_for_Commercial_Use%202018.pdf

5. California Air Resources Board (CARB) 2007 https://www.arb.ca.gov/coatings/arch/Approved_2007_SCM.pdf

1.3 SUBMITTALS

A. Manufacturer’s technical information for all interior applied adhesives, sealants, paints and coatings, indicating VOC content in grams/Liter (g/L).

1. Provide product data indicating compliance with General Emissions evaluation and VOC content requirements.

B. Documentation providing the quantity of each adhesive, sealant, paint, and coating product type used on the Project.

PART 2 - PRODUCTS

2.1 INTERIOR ADHESIVES

A. VOC Limits

1. The volatile organic compound (VOC) content of all field-applied adhesives, adhesive bonding primers, and adhesive primers used on the interior of this Project shall not exceed the limits defined in Rule 1168 - "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California, with a rule amendment date of October 6, 2017.

2. The VOC limits defined by SCAQMD are measured in grams per liter (g/L), less water and less exempt compounds.

3. General: the allowable VOC content for building construction applications, is as follows:

a. Architectural Applications:

1)	Building Envelope Membrane Adhesive	250
2)	Indoor carpet adhesive	50
3)	Carpet Pad Adhesive	50
4)	Wood Flooring Adhesive	100
5)	Rubber Floor Adhesive	60
6)	Subfloor adhesive	50
7)	Ceramic Tile Adhesive	65
8)	VCT and asphalt tile adhesive	50
9)	Drywall and panel adhesive	50
10)	Cove base adhesive	50
11)	Multipurpose construction adhesive	70
12)	Structural glazing adhesive	100

b. Specialty Applications:

1)	PVC welding	510
2)	CPVC welding	490
3)	ABS welding	325
4)	Adhesive primer for plastic	550
5)	Contact Adhesive	80
6)	Special Purpose Contact Adhesive	250

	7)	Adhesive Primer for Traffic Marking Tape	150
	8)	Structural Wood Member Adhesive	140
	9)	Top and trim adhesive	250

c. Substrate Specific Applications:

1)	Metal to metal	30
2)	Plastic foams	50
3)	Porous material (except wood)	50
4)	Wood	30
5)	Fiberglass	80
6)	Reinforced Plastic Composite	250

2.2 INTERIOR AEROSOL ADHESIVES

A. VOC Limits

1. The volatile organic compound (VOC) content of all field-applied aerosol adhesives, used on the interior of this Project shall not exceed the limits defined in the Green Seal standard GS-36, Commercial Adhesives, Edition 2.1, July 12, 2013. Product specific requirements are as follows:

a. Aerosol Adhesives

1)	General purpose mist spray	65% VOCs by weight
2)	General purpose web spray	55% VOCs by weight
3)	Special purpose aerosol adhesives	70% VOCs by weight

2.3 INTERIOR SEALANTS

A. VOC Limits

1. The volatile organic compound (VOC) content of all field-applied adhesives, adhesive bonding primers, and adhesive primers used on the interior of this Project shall not exceed the limits defined in Rule 1168 - "Adhesive and Sealant Applications" of the South Coast Air Quality Management District (SCAQMD), of the State of California.

2. The VOC limits defined by SCAQMD are as follows. All VOC limits are defined in grams per liter, less water and less exempt compounds.

3. General: For specified building construction related applications, the allowable VOC content is as follows:

a. Sealants:

1)	Clear, Paintable, and Immediately Water-Resistant Sealant	280
2)	Foam insulation and sealant	250
3)	Grout Sealant	65
4)	Non-Staining Plumbing Putty	150
5)	Potable Water Sealant	100
6)	Single Ply Roof Membrane Sealants	450
7)	Other Roof Sealants	300
8)	All other Architectural Sealants	250
9)	All other Sealants	420

b. Sealant Primer:

1)	Architectural - Nonporous	250
2)	Architectural- Porous	775
3)	Other	750

2.4 INTERIOR ARCHITECTURAL PAINTS

A. VOC Limits

1. The volatile organic compound (VOC) content of all field-applied architectural paints, used on the interior walls and ceilings of this Project shall not exceed the limits defined in the Green Seal standard GS-11, Paints, Edition 3.2, October 26, 2015. Product specific requirements are as follows:

a. Paints

1)	Flat	50
2)	Non-Flat	100
3)	Non-Flat High Gloss Coatings	150

b. Coatings:

1)	Concrete/Masonry Sealers	100
2)	Fire resistive Coatings	350
3)	Floor coatings	100
4)	Low-Solids Coatings	120

5)	Primers, Sealers, and Undercoaters	100
6)	Roof Coatings	50
7)	Rust Preventative Coatings	250
8)	Wood Coatings	275

2.5 INTERIOR COATINGS

A. VOC Limits

1. The volatile organic compound (VOC) content of all field-applied coating used on the interior of this Project shall not exceed the limits defined in Rule 1113 - "Architectural Coatings" of the South Coast Air Quality Management District (SCAQMD), of the State of California, Amended February 5, 2016.

2. The VOC limits defined by SCAQMD are measured in grams per liter (g/L), less water and less exempt compounds.

3. General: For specified building construction related applications, the allowable VOC content is as follows:

a. Coatings

1)	Building Envelope Coatings		50
2)	Clear Wood Finish:		
	a)	Varnish	275
	b)	Sanding Sealers	275
	c)	Lacquer	275
3)	Concrete-Curing Compounds		100
4)	Dry Fog Coatings		50
5)	Floor Coatings		50
6)	Low-solids Coatings		120*
7)	Magnesite Cement Coatings		450
8)	Primers, Sealers and Undercoaters		100
9)	Shellac		
	a)	Clear	730
	b)	Pigmented	550
10)	Stains		100

11)	Waterproofing Sealers	100
12)	Waterproofing Concrete/Masonry Sealers	100
13)	Wood Preservatives	350

*Note: VOC levels for Low-Solids coatings are measured in grams of VOC per liter of material, including water.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 81 16

SECTION 01 81 19 - INDOOR AIR QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality during and after construction activities.

B. Testing air change effectiveness after completion of construction.

C. Testing Air Isolation and pressurization between compartmentalized areas.

1.2 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.

1. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.

2. Establish condition of existing ducts and equipment prior to start of alterations.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.

C. Furnish products meeting the specifications.

D. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

E. Ventilation: HVAC system has been designed to achieve the minimum requirements for ventilation specified in ASHRAE 62.1.

F. Air Isolation: Rooms have been designed with impermeable party walls and sealed openings in walls and floors.

1.3 RELATED SECTIONS

A. Section 01 40 00 – “Quality Requirements”: Testing and inspection services.

B. Section 01 81 16 – “Volatile Organic Compound (VOC) Content Requirements.

C. Section 23 05 93 – “Testing, Adjusting, and Balancing”: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

D. Section 23 31 13 – “Metal Ducts”: Cleaning air ducts, equipment, and terminal units.

1.4 REFERENCES

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017.

B. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality; 2016.

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C. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).

D. ASTM E 779-19 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; 2019.

E. SMACNA IAQ Guidelines for Occupied Buildings Under Construction, 2nd edition ANSI/SMACNA 008•2008.

1.5 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for “Occupied Buildings Under Construction” as a guide.

1. Identify potential sources of odor and dust.
2. Identify construction activities likely to produce odor or dust.
3. Identify areas of project potentially affected, especially occupied areas.
4. Evaluate potential problems by severity and describe methods of control.
5. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
6. Describe cleaning and dust control procedures.

C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of assembly and application, and curing times.

D. Duct and Terminal Unit Inspection Report.

PART 2 PRODUCTS

2.1 MATERIALS

A. Low VOC Materials: See Section 01 81 16 - VOC Limits For Adhesives, Sealants, Paints, and Coatings , and other materials and systems Division Sections for specific requirements for materials with low VOC content.

B. Auxiliary and Construction Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE 52.2.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:

1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.

2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.

3. Provide sufficient ventilation for drying within reasonable time frame.

B. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; clean area and remove dust and dirt completely before restarting systems.

C. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.

D. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

E. Store and protect products in accordance with manufacturers' instructions.

F. Store with seals and labels intact and legible.

G. Store sensitive products on skids or pallets in weather tight, climate controlled, enclosures in an environment favorable to product.

H. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

N. HVAC equipment and supply air ductwork may be used for ventilation during construction:

1. Operate HVAC system on 50 percent outside air, with 1.5 air changes per hour, minimum.

2. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air; provide alternate return air pathways.

3. Inspect MERV 8 air filtration media at least once a week. Change out filtration media when dirty.

O. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.

1. Inspect duct intakes, return air grilles, and terminal units for dust.

2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.

3. Clean tops of doors and frames.

4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.

5. Clean return plenums of air handling units.

6. Remove intake filters last, after cleaning is complete.

P. Do not perform dusty or dirty work after return air ducts are in-use without proper intake filters.

Q. Use other relevant recommendations of SMACNA IAQ “Guideline for Occupied Buildings Under Construction” for avoiding unnecessary contamination due to construction procedures.

3.2 FLUSH-OUT

A. Perform flush-out before occupancy.

B. Do not start flush-out until:

1. All construction is complete.

2. HVAC systems are tested, adjusted, and balanced for proper operation.

3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.

4. New HVAC operational filtration media have been installed.

C. Partial Flush-Out: Operate all ventilation systems at normal flow rates with specified conditioned outside air until a total air volume of 4,000 cubic feet per square foot of floor area has been supplied. Store occupancy and operations can take place after the specified volume of air is supplied.

1. Complete air and water side test and balance before beginning flush-out
2. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
3. Maintain interior temperature of at least 60 degrees F (15 degrees C) and interior relative humidity no higher than 60 percent.
4. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
5. Begin ventilation at least three hours prior to daily occupancy.
6. Continue ventilation during all occupied periods.

D. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

END OF SECTION 01 81 19

SECTION 03 11 16.13 – CONCRETE FORM LINERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reusable form liners for texturing architectural concrete.

B. Material:

1. ABS Plastic Form liner

C. Standard Pattern:

1. Wood Pattern

D. Form liner accessories as required for complete installation.

1.2 RELATED SECTIONS

A. Section 03 10 00 – Concrete Forming and Accessories.

B. Section 03 11 16 – Architectural Cast-in Place Concrete Forming.

C. Section 03 11 19 – Insulating Concrete Forming.

D. Section 03 45 13 – Photo-engraved Architectural Precast Concrete.

E. Section 03 45 00 – Precast Architectural Concrete.

F. Section 03 47 13 – Tilt-Up Concrete.

G. Section 09 97 23 – Concrete and Masonry Coatings.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117 - Tolerances for Concrete Construction and Materials.

B. ASTM International (ASTM):

1. ASTM D412 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
2. ASTM 638 – Standard Test Method for Tensile Properties of Plastics.
3. ASTM D2240 - Standard Test Method for Rubber Property - Durometer Hardness.
4. ASTM D1456 - Standard Test Method for Rubber Property – Elongation.

1.4 SUBMITTALS

A. Section 01 30 00 –Submittal Procedures.

B. Shop Drawings: Complete details of materials and installation, including but not limited to the following.

1. Patterns.
2. Form liner sheet sizes/accessory details.
3. Joint locations
4. Installation sequence

C. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Product sheets showing form liner name, model, and pattern number.
2. Form liner system preparation and installation procedures.
3. Form liner application guide.
4. Maintenance procedures.
5. Storage and handling guidelines.

D. Samples for Selection: For range of form liner types and patterns requested by Architect.

1. Form liner sample, maximum 24 x 24 inches (610 x 610 mm) depicting textures and patterns.
2. Renderings.
3. Sample of release agents available for releasing of form liners from concrete.

E. Verification Samples: For each form liner type and pattern specified.

1. Form liner sample, maximum 24 x 24 inches (610 x 610 mm) representing actual product, pattern and texture.
2. Sample of release agent to be used for releasing of form liners from concrete.

F. Quality Assurance Submittals: Copies of test reports conducted by independent laboratories verifying the characteristics of the form liner shall be submitted to the Architect upon request.

G. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.

H. Warranty: A copy of the manufacturer's product warranty shall be provided upon request.

1.5 QUALITY ASSURANCE

A. Single Source Requirements: Form liners, primary and secondary components necessary for the installation of the form liner shall be supplied from a single manufacturer.

B. Manufacturer Qualifications: Manufacturer shall have a minimum of ten years' experience manufacturing form liners.

C. Installer Qualifications: Precast fabricator or cast-in-place, installer shall have a minimum of three years documented experience working with form liners.

D. Mock-Up: A mock-up panel shall be constructed to demonstrate the texture and pattern of form liners selected as well as the surface preparation techniques and craftsmanship of the installer and precast manufacturer.

1. 1The mock-up panel shall accurately demonstrate the specified form liner textures, patterns, and conditions (corners, false joints, etc.) expected in the completed work.

2. Install mock-up panel in area designated by Architect.

3. Construct mock-up using the exact procedures to be used in the full-scale construction.

4. Architect must approve the texture, pattern, color, and workmanship of the mock-up panel prior to the beginning of concrete construction. Do not proceed with remaining work until workmanship, installation and operation are approved by Architect.

5. Mock-up panel must remain on-site for comparison purposes during concrete construction or erection.

6. The installer or precast manufacturer shall be responsible for the removal and disposal of the mock-up panel following completion of the project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspect the materials upon delivery to ensure that specified products have been received. If there are any discrepancies upon inspection, the manufacturer must be immediately notified. Do not use damaged products.

B. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Cover form liners when not in use to protect from water, oil, dirt, and UV exposure. If building storage is not available, form liners shall be raised from the ground and covered securely with non-transparent, non-translucent, waterproof covers.

C. Store materials within absolute limits for temperature and humidity recommended by manufacturer. Liquid materials shall be stored in temperatures not exceeding 110 degrees F (43 degrees C) or falling below 32 degrees F (0 degrees C). Protect from damage.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 SEQUENCING

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

B. Pre-Installation/Pre-Manufacture Meeting: Convene minimum two weeks prior to starting work of this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Symons by Dayton Superior Corporation, which is located at: 1125 Byers Road; Miamisburg, OH 45342; Tel: 800-800-7966; Web: http://www.symons.com

B. Substitutions: Not permitted.

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

2.2 MATERIALS

A. Reusable form liner for architectural concrete

1. Description: Form liners for creating textured surfaces on cast-in-place or precast concrete. The ABS plastic form liner exhibits good impact resistance and excellent overall performance. Its reuse factor is 10, subject to pattern configuration, proper handling and jobsite configurations.

2. Material Properties: As tested according to ASTM D2240.

3. Material Thickness: .110

4. Material Weights – lbs./ft²: 1-2 lbs.

5. Standard Dimensions: 4‘ x 10‘.

6. Product Code Number: F940005

7. Color: Gray

8. Pattern Style: Wood

    a. Pattern: 4” Variable Depth Rough Cedar.

2.3 ACCESSORY MATERIALS

A. Form liner Accessories: Form oil and adhesives as required for the complete form liner system as per manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Attachment - Handset Systems; Plastic Form liners:

1. Apply foam tape to plate or sill supporting formwork to prevent grout leakage at base of plastic form liner.
2. Assemble and brace the architectural side of the formwork first; attach form liner before setting ties or opposite formwork side.
3. Apply foam tape to back side of form liner along all edges; allow foam tape to extend beyond the edge when the form liner will be jointed.
4. Work with one sheet at a time; position form liner against formwork so that edges, pattern, and joints are square.
5. Staple form liner on 3-inch (76 mm) centers and around all tie locations; using adequate electrical power, drive staple heads flush with surface.
6. Position foam tape behind the joint of two pieces and press down firmly.
7. Insert grout seal block to support joint and prevent grout seepage.
8. Insert grout seal blocks as required to seal tie holes, fill voids in boxouts and open-ended patterns, or support especially deep patterns.

B. Attachment - Gang form Systems; Plastic Form liners:

1. Level and square formwork so that attachment can be made in a horizontal plane; mark dimensions so that edges, patterns, and joints are square.
2. If required, attach strong backs to the formwork holding the form liner.
3. Apply foam tape to back side of form liner along all edges; allow foam tape to extend beyond the edge when the form liner will be jointed.
4. Work with one sheet at a time; position form liner against formwork so that edges, pattern, and joints are square.
5. Staple form liner on 3-inch (76 mm) centers and around all tie locations; using adequate electrical power, drive staple heads flush with surface.
6. Position foam tape behind the joint of two pieces and press down firmly; make attachment.
7. Insert grout seal blocks as required to seal tie holes, fill voids in boxouts and open-ended patterns, or support especially deep patterns.

END OF SECTION 03 11 16.13

SECTION 03 30 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

B. Related Sections include the following:

1. Section 01 73 29 “Cutting and Patching” for concrete finish work at exterior and demising walls.
2. Section 02 41 00 “Selective Demolition” for excavation and fill requirements at site paved areas.
3. Section 05 12 00 “Structural Steel Framing” for anchorage of structural steel members to concrete construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping form-work, shoring removal, and installing and removing reshoring.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Material Certificates: Signed by manufacturers certifying that each of the following items comply with requirements:

1. Cementitious materials and aggregates.
2. Form materials and form-release agents.
3. Steel reinforcement and reinforcement accessories.
4. Fiber reinforcement.

5. Admixtures.
6. Waterstops.
7. Curing materials.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Epoxy joint filler.
13. Joint-filler strips.
14. Repair materials.

G. Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

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

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 30 00"Administrative Requirements."

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1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixes.
    c. Ready-mix concrete producer.
    d. Concrete subcontractor.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Floor Slabs, Walls, Columns, Ceilings, or Roofs exposed to view.
    1. Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
    2. Plywood, metal, or other approved panel materials.
    3. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
        a. Medium-density overlay, Class 1, or better, mill-release agent treated, and edge sealed.

B. Rough-Formed Finished Concrete: Foundations, Apron Walls, or other surfaces not exposed to view.
    1. Plywood, lumber, metal, or another approved material.
    2. Provide lumber dressed on at least two edges and one side for a tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Form-Release Agent: Commercially formulated low VOC form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
    1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
    1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of

the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed from U.S. domestic manufacturer only.

B. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips.

1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars.

C. Plain-Steel Wire: ASTM A 82, as drawn.

D. Deformed-Steel Wire: ASTM A 496.

E. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber- reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Moderate weathering region, but not less than 3M.

2. Nominal Maximum Aggregate Size: 1 inch (25 mm), or as indicated on drawings.

3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).

B. Lightweight Aggregate: ASTM C 330.

1. Nominal Maximum Aggregate Size: as indicated drawings. C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-

soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E. F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

F. Corrosion-Inhibiting Admixture: When indicated use commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. DCI or DCI-S; W. R. Grace & Co., Construction Products Div.

b. Rheocrete 222+; Master Builders, Inc.

c. FerroGard-901; Sika Corporation.

2.6 VAPOR RETARDERS

A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials.

1. Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick:

2. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.

3. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Griffolyn T-85" by Reef Industries Inc.

B. Fine-Graded Granular Material: When indicated on drawings use clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 per- cent passing a No. 4 (4.75-mm) sieve and 10 to 30 percent passing a No. 100 (0.15-mm) sieve; meeting deleterious substance limits of ASTM C 33 for fine aggregates.

C. Granular Fill: When indicated on drawings use clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent, passing a No. 8 (2.36-mm) sieve.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. (305 g/sq. m) dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 22 percent solids.

G. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Evaporation Retarder:
   a. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
   b. Sure Film; Dayton Superior Corporation.
   c. Eucobar; Euclid Chemical Co.
   d. SikaFilm; Sika Corporation.
2. Clear, Waterborne, Membrane-Forming Curing Compound:
   a. AH Clear Cure WB; Anti-Hydro International, Inc.
   b. Klear Kote WB II Regular; Burke Chemicals.
   c. Safe-Cure & Seal 20; ChemMasters.
3. Clear, Waterborne, Membrane-Forming Curing Compound, 18 to 22 Percent Solids:
   a. Klear Kote WB II 20 percent; Burke Chemicals.
   b. Safe-Cure & Seal 20; ChemMasters.
   c. Conspec 21; Conspec Marketing & Manufacturing Co., Inc.

2.8 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

B. Epoxy Joint Filler: Two-component, semi rigid, 100 percent solids, and epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-re dispersible, acrylic emulsion or styrene butadiene.

D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as

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recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi (39 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Footings, Foundation Walls, and Walls: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4500 psi (20.7 MPa).
2. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches (200 mm) after admixture is added to concrete with 2- to 4-inch (50- to 100-mm) slump.
3. Maximum water/cement ratio shall not exceed 0.50.

C. Slab-on-Grade: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4500 psi (20.7 MPa).
2. Minimum Cementitious Materials Content: 520 lb. /cu. yd. (309 kg/cu. m).
3. Maximum Slump: 4 inches (100 mm).
4. Maximum water/cement ratio shall not exceed 0.50.

D. Suspended Slabs: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 4500 psi (27.6 MPa).
2. Maximum Slump: 4 inches (100 mm).
3. Maximum water/cement ratio shall not exceed 0.45.

E. Cementitious Materials: With a previous approval of the Structural Engineer, Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or Pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent Portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

F. Maximum Water-Cementitious Materials Ratio: Shall be as indicated on drawings and on articles 2.13, C, D, E & F of these specifications, but under any circumstances shall be more than 0.55.

G. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content: 4 percent for 1-1/2-inch- (38-mm-) nominal maximum aggregate size.
2. Air Content: 4.5 percent for 1-inch- (25-mm-) nominal maximum aggregate size.
3. Air Content: 4.5 percent for 3/4-inch- (19-mm-) nominal maximum aggregate size.
4. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

H. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.

1. When the air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm).

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to pre- vent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, which does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations, and provided that curing and protection operations are

maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, which supports weight of concrete in place until concrete has achieved the following:

1. At least 70 percent of 28-day design compressive strength.
2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

E. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete sur- faces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and re-shore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. Fine-Graded Granular Material: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

C. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

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

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Fasten epoxy-coated reinforcement with epoxy-coated steel wire ties. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Do not Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. When not indicated on drawings locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. When not indicated in drawings locate horizontal joints in walls and columns at under- side of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip joint filler strip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm.

1. Install waterstop in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install waterstop in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while the preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.

2. Do not apply rubbed finish to smooth-formed finish.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor top- ping or mortar setting beds for ceramic or quarry tile, Portland cement terrazzo, and other bonded cementitious floor finishes.

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

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

roofing, or sand-bed terrazzo.

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

1. Apply a trowel finish to surfaces indicated and to floor and slab 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, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thick-set or thin-set method. Immediately after a second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

1. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and else- where as indicated.

2. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

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

1. Uniformly spread 25 lb. /100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

a. After broadcasting and tamping, apply float finish.

b. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

3.12 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, com-plying with diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

E. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot

temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if the surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, to finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured for at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing them with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

5. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing them with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4-inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish blending with adjacent finished concrete. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove the top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Use epoxy adhesive and patching mortar for concrete structural repairs, subject to Architect's approval,

1. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

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

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mix, 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 placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of six

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standard cylinder specimens for each composite sample.

a. Cast and field cure one set of six standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test three laboratory-cured specimens at 7 days and three at 28 days for normal reinforced concrete and three field-cured at 1 day for post-tensioned concrete slabs and other structural elements.

a. A compressive-strength test shall be the average compressive strength from three specimens obtained from same composite sample and tested at age indicated.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION 03 30 00

SECTION 03 33 10 - CAST-IN-PLACE ARCHITECTURAL CONCRETE

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 specifies cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

B. Related Sections include the following:

1. Division 2 Section "Cement Concrete Pavement" for concrete pavement and flatwork finishes.
2. Division 2 Section "Decorative Cement Concrete Pavement" for surface-imprinted concrete pavement and finishes.
3. Division 3 Section “Concrete Form Liners” for reusable form liners for texturing architectural concrete.
4. Division 3 Section "Cast-in-Place Concrete" for re-usable formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
5. Division 7 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

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

C. Formwork Shop Drawings: Show formwork construction including form face finish, form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations

and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

E. Samples: For each of the following materials:

1. Form-facing panel.
2. Form ties.
3. Form liners.
4. Coarse- and fine-aggregate gradations.
5. Chamfers and rustications.

F. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

G. Qualification Data: For Testing agency.

H. Material Certificates: For each of the following, signed by manufacturer:

1. Cementitious materials.
2. Coarse aggregates.
3. Fine aggregates
4. Admixtures.
5. Form materials and form-release agents.
6. Repair materials.

I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. The Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations for Cast-in-Place Architectural Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete, Sections 1 through 5 and Section 6, "Architectural Concrete."

2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under sample submittals. Produce a minimum of 3 sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.

2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.

3. In the presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.

4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

5. Demolish and remove field sample panels when directed.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Ready-mix concrete manufacturer.

d. Cast-in-place architectural concrete subcontractor.

2. Review concrete finishes and finishing, hot-weather concreting procedures, [curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair materials, methods, and procedures, and protection of cast-in-place architectural concrete.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for As-Cast Finishes: Steel, or Exterior-grade plywood panels, with nonabsorptive form face, that will provide continuous, true, and smooth architectural concrete surfaces, medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1.

C. Rustication Strips: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch minimum; nonstaining; in longest practicable lengths.

E. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inches thick.

F. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, which adheres to form joint substrates.

G. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

H. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.

J. Form Ties: Factory-fabricated, removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish ties with tapered tie cone spreaders that, when removed, will leave 1 inch in diameter holes on the concrete surface.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place; manufacture according to CRSI's "Manual of Standard Practice."

1. Where legs of wire bar supports contact forms, use gray, all-plastic CRSI Class 1 bar supports.

2.3 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

2. Blended Hydraulic Cement: ASTM C 595, Type I (PM), pozzolan-modified portland cement.

B. Normal-Weight Aggregates: ASTM C 33, Class 5S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse Aggregate Size: 3/4 inch.

2. Gradation: Uniformly graded.

C. Normal-Weight Fine Aggregate: ASTM C 33, manufactured or natural sand, from same source for entire Project.

D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 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.

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.

7. Color: Match Architect's sample.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

1. Type IV or V Grade 1 load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

B. Proportion concrete mixtures as follows:

1. Compressive Strength (28 Days): 4,000 psi (27.6 MPa).
2. Maximum Water-Cementitious Materials Ratio: 0.46.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

D. Limit water-soluble, chloride-ion content in hardened concrete to a maximum of 0.30 percent by weight of cement.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

2.8 CONCRETE MIXING

A. Ready-Mixed or Site-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. Clean the equipment that is used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When the air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 60 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 45 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class B, 1/4 inch (6 mm).

D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.

2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. **Chamfer** all exterior corners and edges of cast-in-place architectural concrete.

H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Re-tighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERTS

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work may be removed after cumulatively curing at not less than 36 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved field sample panels.

2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

B. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.

2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete, clean, and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless prior approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

E. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Do not repair and patch tie holes. Repair bug holes and other defects.

B. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

A. General: Comply with Division 3 Section "Cast-in-Place Concrete" for field quality-control requirements.

3.10 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during the remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after the finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 03 33 10

SECTION 03 35 20 - CONCRETE FLOOR TOPPING

PART 1 - GENERAL

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.1 SUMMARY

A. This Section includes the following:

1. Mineral-aggregate concrete floor topping.

2. Metallic-aggregate concrete floor topping.

B. Related Sections include the following:

1. Section 03 30 00 "Cast-in-Place Concrete" for slabs-on-grade concrete construction and finish.

2. Section 07 92 00 “Joint Sealers” for control and expansion joint sealer materials.

1.2 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results of toppings for compliance with requirements indicated.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.

1. Place topping only when ambient temperature and temperature of base slabs are between

50 and 86 deg F (10 and 30 deg C).

B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Mineral-Aggregate Topping:
    a. A-H Emery A-1 Premix; Anti-Hydro International, Inc.
    b. Emery Tuff Top; Dayton Superior Corporation.
    c. Emerytop 400; L&M Construction Chemicals, Inc.
    d. Met-Top E; Metalcrete Industries.
    e. Emeri-Crete Topping; Sternson Group.
2. Iron-Aggregate Topping:
    a. A-H Irontop; Anti-Hydro International, Inc.
    b. Iron Topping RM; Burke Group, LLC (The).
    c. Conplate Floor Topping; Conspec Marketing & Manufacturing Co., Inc.
    d. Super Euco-Top; Euclid Chemical Co.
    e. Mastertop 300 Anvil-Top; Master Builders, Inc.
    f. Metalcrete; Metalcrete Industries.
    g. Ferrotop; Sternson Group.

2.2 CONCRETE FLOOR TOPPINGS

A. Mineral-Aggregate Topping: Factory-prepared and dry-packaged mixture of graded, crushed emery aggregate containing not less than 50 percent aluminum oxide, not less than 24 percent ferric oxide, and not more than 8 percent silica; Portland cement or blended hydraulic cement; plasticizers; and other admixtures to which only water needs to be added at Project site.

1. Compressive Strength (28 Days): 7000 psi (48 MPa); ASTM C 109/C 109M.

B. Iron-Aggregate Topping: Factory-prepared and dry-packaged mixture of graded iron aggregate, Portland cement, plasticizers, and other admixtures to which only water needs to be added at Project site.

1. Compressive Strength (28 Days): 10,000 psi (69 MPa); ASTM C 109/C 109M.

2.3 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 25 percent solids content, minimum.

2.4 RELATED MATERIALS

A. Epoxy Joint Filler: Two-component, semi rigid, 100 percent solids epoxy resin with a Shore A hardness of 80 per ASTM D 2240. Preferred product is Sika Loadflex-524 EZ.

1. Use in saw-cut Control Joints in concrete topping directly above all double tee union joints, and at beam and double tee union joints.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self- expanding cork.

C. Portland Cement: ASTM C 150, Type I or II.

D. Sand: ASTM C 404, fine aggregate passing No. 16 (1.2-mm) sieve.

E. Water: Potable.

F. Acrylic-Bonding Agent: ASTM C 1059, Type II, non-dispersible, acrylic emulsion or styrene butadiene.

G. Epoxy Adhesive: ASTM C 881, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

2.5 MIXING

A. Bonding Slurry: Mix 1 part Portland cement and 1-1/2 2 2-1/2 parts sand with water and an acrylic bonding agent according to manufacturer’s written instructions to a thick paint consistency.

B. Topping: Mix topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of topping. Proceed with application only after unsatisfactory conditions have been corrected.

B. Verify that base slabs meet finish and surface profile requirements in Division 3 Section "Cast-in-Place Concrete."

C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.

3.2 PREPARATION

A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of 1/4 inch (6 mm.)

1. Prepare and clean existing base slabs according to topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.

2. Mechanically remove contaminants from existing concrete that might impair bond of topping.

3. Saw cut existing contraction and construction joints to a depth of 1/2 inch (13 mm) and fill with epoxy joint filler.

B. Install joint-filler strips where topping abuts vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with topping surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips 1/2 inch (13 mm) below topping surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.3 TOPPING APPLICATION

A. Monolithic Topping: After textured-float finish is applied to fresh concrete of base slabs, specified in Division 3 Section "Cast-in-Place Concrete," place topping while concrete is still plastic.

B. Deferred Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of 1/16 to 1/8 inch (1.5 to 3 mm), without puddling. Place topping while slurry is still tacky.

C. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of 1/16 to 1/8 inch (1.5 to 3 mm), without puddling. Place top- ping while adhesive is still tacky.

D. Place topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.

1. Screed surface with a straightedge and strike off to correct elevations.

2. Slope surfaces uniformly where indicated.

3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free

of humps or hollows.

E. Finishing: Consolidate surface with power-driven floats as soon as topping can support equipment and operator. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate topping by power-driven trowel so no blisters develop. Continue troweling passes and re-straighten until surface is smooth and uniform in texture.

a. Finish surfaces to specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15, measured within 24 hours according to ASTM E 1155 (ASTM E 1155M) for a randomly trafficked floor surface.

F. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of topping, at locations indicated or as approved by Architect.

1. Coat face of construction joint with epoxy adhesive at locations where topping is placed against hardened or partially hardened topping.

G. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before topping develops random contraction cracks.

1. Form joints in topping over contraction joints in base slabs, unless otherwise indicated.

2. Construct contraction joints for a combined depth equal to topping thickness and not less than one- fourth of base-slab thickness.

3. Construct contraction joints for a depth equal to one-half of topping thickness, but not less than ½ inch (13 mm) deep.

3.4 PROTECTION AND CURING

A. General: Protect freshly placed topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying topping, but before float finishing.

C. Begin curing immediately after finishing topping. Cure by one or a combination of the following methods, according to topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with continuous water-fog spray or continuously water saturated absorptive cover. Cover topping surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12

inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.5 JOINT FILLING

A. Prepare and clean contraction joints and install epoxy joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install epoxy joint filler full depth of contraction joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.6 REPAIRS

A. Defective Topping: Repair and patch defective topping areas, including areas that have not bonded to concrete substrate.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform tests and to prepare test reports.

B. Sample Sets: At point of placement, testing and inspecting agency shall take a set of 3 molded-cube samples from the topping mix for the first 1,000 sq. ft. (93 sq. m) plus 1 set of samples for each subsequent 5,000 sq. ft. (464 sq. m) of topping, or fraction thereof, but not less than 6 samples for each day's placement. Samples shall be tested according to ASTM C 109/C 109M for compliance with compressive strength requirements.

END OF SECTION 03 35 20

SECTION 03 54 16 - SELF-LEVELING CEMENT UNDERLAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydraulic Self-Leveling cement underlayment and surface preparation.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 09 30 00 – Tiling.

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM C 109/C 109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
2. ASTM C 150/C 150M - Standard Specification for Portland Cement.
3. ASTM C 219 - Standard Terminology Relating to Hydraulic Cement.
4. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
5. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
6. ASTM E 492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.
7. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Environmental Product Declarations (EPD) and certificates as required by Section 01 81 16 VOC Limits, and Section 01 60 00 Product Requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-years‘ experience manufacturing similar products.

B. Installer Qualifications: Minimum 2-years' experience installing similar products.

C. 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 approved by the Architect.

3. Refinish mock-up area as required to produce acceptable work.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 SEQUENCING

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: MAPEI: 1144 E. Newport Center Rd.; Deerfield Beach, FL 33442; Toll Free Tel: 800-42-MAPEI; Tel: 954-246-8888; Fax: 954-246-8801; Email: request info (techservicerequests@mapei.com/US-EN); Web: www.mapei.com/US-EN

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

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1. Refer to drawings for UL assemblies required.

B. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 492 and classified according to ASTM E 989 by an independent testing agency.

2.3 HYDRAULIC CEMENT UNDERLAYMENTS

A. Quick-Setting, Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/8 inch to 1 inch (3 mm to 25 mm).

1. Product: Subject to compliance with requirements, provide MAPEI Corporation; Novoplan 2 Plus.

B. High-Performance, Quick-Setting, Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied from feather edge to 1-1/2 inches (38 mm).

1. Product: Subject to compliance with requirements, provide MAPEI Corporation; Ultraplan 1 Plus.

C. Lightweight, Self-Leveling Underlayment, polymer modified, calcium-aluminate based, self drying specifically designed for use as a self-leveling underlayment over subfloors that are not rated carry the full weight of traditional self-leveling underlayments from 1/8 inch to 2 inches (3mm to 5 cm),

1. Product: Subject to compliance with requirements, provide MAPEI Corporation; Ultraplan Lite.

D. Performance Requirements:

1. Cement Binder: ASTM C 150/C 150M, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.

2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.

E. Aggregate: Well-graded, coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

F. Water: Potable and at a temperature of not more than 70 degree F (21 degree C).

G. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

1. Multipurpose Bond-Promoting Primer:

a. Product: Subject to compliance with requirements, provide MAPEI Corporation: ECO Prim Grip.

2. VOC Content: Provide primer with VOC content of 200 g/L.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.

2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 5 lbs of water/1000 sq. ft. (2,27 kg of water/100 sq. m) in 24 hours.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Installation underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

G. Sound Control Mat and Board: Install sound control materials according to manufacturer's written instructions.

1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after

application recommended in writing by manufacturer.

2. Coordinate application of components to provide optimum adhesion to substrate and between coats.

3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregating to product surface.

2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after the time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 54 16

SECTION 04 05 03 - MASONRY MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

1.2 Related Sections:

A. Section 04 20 16 – “Reinforced Unit Masonry”

1.3 REFERENCES

A. ASTM International:

1. ASTM C91 - Standard Specification for Masonry Cement.
2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
3. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
5. ASTM C150 - Standard Specification for Portland Cement.
6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
8. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
10. ASTM C476 - Standard Specification for Grout for Masonry.
11. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
12. ASTM C1019 – Standard Test Method for Sampling and Testing Grout.
13. ASTM C1329 - Standard Specification for Mortar Cement.

B. The Masonry Society:

1. TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.4 SUBMITTALS

A. Section 01 30 00: “Administrative Requirements”.

B. Test Reports:

1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.

2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476, component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

C. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Product Data for products having recycled material content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Product

F. Data for products having regionally extracted and manufactured material content, documentation indicating percentages by weight of each regional material.

1.5 QUALITY ASSURANCE

A. Testing CMU Grout:

1. Determine and certify that proportions of ingredients for mix design will provide the specified compressive strength for each type of grout.

2. Test mix design prior to beginning construction of CMU walls.

3. Required testing will be performed in accordance with Section 01 40 00– “Quality Requirements”.

4. Prepare test specimens in accordance with Section 01 40 00– “Quality Requirements”.

B. CMU Mortar: Determine and certify that proportions of ingredients for mix design in accordance ASTM C 270 or IBC Standard 2130.7 will provide the specified strength.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – “Product Requirements”.

B. Hot Weather Requirements: TMS MSJC Specification.

PART 2 - PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers:

1. Bonsal (WR Bonsal Co.)

2. Burke Co.

3. The Quikrete Companies.

4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color. Slag, and pozzolans not permitted as substitutes for Portland Cement. Fly ash may be used not exceeding 15% of the cement weight and shall conform to ASTM C618, Class F.

B. Premix Mortar: ASTM C387, Type M, using gray color cement.

C. Mortar Aggregate: ASTM C144, standard masonry type, clean, dry, protected against dampness and foreign matter.

D. Hydrated Lime: ASTM C207, Type S.

E. Quicklime: ASTM C5, non-hydraulic type.

F. Grout Aggregate: ASTM C404, fine and coarse, maximum size 3/8” inch.

G. Water: Clean and potable.

2.3 MIXES

A. Mortar For Structural Masonry: ASTM C270, Type M, S, N using Proportion specification.

B. Mortar For Non-Structural Masonry: ASTM C270, Type M, S, N, O using Proportion specification.

C. Pointing Mortar: ASTM C270, Type N, O, duplicate original mortar proportions. Add aluminum tri-stearate, calcium stearate, or ammonium stearate equal to 2% of Portland cement weight.

D. Mortar Mixing:

1. Thoroughly mix mortar ingredients in accordance with ASTM C270 or IBC Standard 2130.7, in quantities needed for immediate use.

2. Achieve uniformly damp sand immediately before mixing process.

3. Re-temper only within two hours of mixing.

E. Grout Mixes:

1. Grout for Structural and Non-Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine grout.

F. Application:

1. Coarse Grout: For grouting spaces with minimum 4 inches (100 mm) dimension in every direction.

2. Fine Grout: For grouting other spaces.

3. Do not use air-entrainment admixtures.

G. Grout Mixing:

1. Mix grout in accordance with ASTM C94 or IBC Standard 21-19 and IBC Standard 19-3, modified to use ingredients complying with ASTM C476.

2. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.

3. Add admixtures; mix uniformly.

H. Regional Materials:

1. Aggregate for mortar and grout, including cement, sand and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – “Administrative Requirements”: Coordination and project conditions.

B. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

3.3 INSTALLATION

A. Install mortar and grout in accordance with Section 04 20 16 - Reinforced Unit Masonry.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 – “Quality Requirements” 01 78 00 – “Closeout Procedures”: Field inspecting, testing, and adjusting.

B. Establishing Mortar Mix: In accordance with ASTM C270.

C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.

D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength and in accordance with ASTM C143 for slump.

E. Waste Disposal: Deposit all masonry grout and mortar waste along with other cementitious waste in a lined pit or container and recycle per specifications section 01 74 19 “Construction Waste Management”.

END OF SECTION 04 05 03

SECTION 04 05 03 - MASONRY MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

1.2 Related Sections:

A. Section 04 20 16 – “Reinforced Unit Masonry”

1.3 REFERENCES

A. ASTM International:

1. ASTM C91 - Standard Specification for Masonry Cement.
2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
3. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
5. ASTM C150 - Standard Specification for Portland Cement.
6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
8. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
10. ASTM C476 - Standard Specification for Grout for Masonry.
11. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
12. ASTM C1019 – Standard Test Method for Sampling and Testing Grout.
13. ASTM C1329 - Standard Specification for Mortar Cement.

B. The Masonry Society:

1. TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.4 SUBMITTALS

A. Section 01 30 00: “Administrative Requirements”.

B. Test Reports:

1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.

2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476, component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

C. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Product Data for products having recycled material content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Product

F. Data for products having regionally extracted and manufactured material content, documentation indicating percentages by weight of each regional material.

1.5 QUALITY ASSURANCE

A. Testing CMU Grout:

1. Determine and certify that proportions of ingredients for mix design will provide the specified compressive strength for each type of grout.

2. Test mix design prior to beginning construction of CMU walls.

3. Required testing will be performed in accordance with Section 01 40 00– “Quality Requirements”.

4. Prepare test specimens in accordance with Section 01 40 00– “Quality Requirements”.

B. CMU Mortar: Determine and certify that proportions of ingredients for mix design in accordance ASTM C 270 or IBC Standard 2130.7 will provide the specified strength.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – “Product Requirements”.

B. Hot Weather Requirements: TMS MSJC Specification.

PART 2 - PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers:

1. Bonsal (WR Bonsal Co.)

2. Burke Co.

3. The Quikrete Companies.

4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color. Slag, and pozzolans not permitted as substitutes for Portland Cement. Fly ash may be used not exceeding 15% of the cement weight and shall conform to ASTM C618, Class F.

B. Premix Mortar: ASTM C387, Type M, using gray color cement.

C. Mortar Aggregate: ASTM C144, standard masonry type, clean, dry, protected against dampness and foreign matter.

D. Hydrated Lime: ASTM C207, Type S.

E. Quicklime: ASTM C5, non-hydraulic type.

F. Grout Aggregate: ASTM C404, fine and coarse, maximum size 3/8” inch.

G. Water: Clean and potable.

2.3 MIXES

A. Mortar For Structural Masonry: ASTM C270, Type M, S, N using Proportion specification.

B. Mortar For Non-Structural Masonry: ASTM C270, Type M, S, N, O using Proportion specification.

C. Pointing Mortar: ASTM C270, Type N, O, duplicate original mortar proportions. Add aluminum tri-stearate, calcium stearate, or ammonium stearate equal to 2% of Portland cement weight.

D. Mortar Mixing:

1. Thoroughly mix mortar ingredients in accordance with ASTM C270 or IBC Standard 2130.7, in quantities needed for immediate use.

2. Achieve uniformly damp sand immediately before mixing process.

3. Re-temper only within two hours of mixing.

E. Grout Mixes:

1. Grout for Structural and Non-Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine grout.

F. Application:

1. Coarse Grout: For grouting spaces with minimum 4 inches (100 mm) dimension in every direction.

2. Fine Grout: For grouting other spaces.

3. Do not use air-entrainment admixtures.

G. Grout Mixing:

1. Mix grout in accordance with ASTM C94 or IBC Standard 21-19 and IBC Standard 19-3, modified to use ingredients complying with ASTM C476.

2. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.

3. Add admixtures; mix uniformly.

H. Regional Materials:

1. Aggregate for mortar and grout, including cement, sand and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – "Administrative Requirements": Coordination and project conditions.

B. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

3.3 INSTALLATION

A. Install mortar and grout in accordance with Section 04 20 16 - Reinforced Unit Masonry.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 – "Quality Requirements" 01 78 00 – "Closeout Procedures": Field inspecting, testing, and adjusting.

B. Establishing Mortar Mix: In accordance with ASTM C270.

C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.

D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength and in accordance with ASTM C143 for slump.

E. Waste Disposal: Deposit all masonry grout and mortar waste along with other cementitious waste in a lined pit or container and recycle per specifications section 01 74 19 "Construction Waste Management".

END OF SECTION 04 05 03

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar and masonry accessories.

B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

1. Include the design engineer's stamp or seal on each sheet of shop drawings.

C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.02 QUALITY ASSURANCE

A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of Contract Documents.

B. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Puerto Rico.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.

2. Load-Bearing Units: ASTM C90, normal weight.

a. Hollow block, as indicated.

3. Non-Loadbearing Units: ASTM C129.

a. Hollow block, as indicated.

b. Normal weight.

2.02 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

G. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

1. Type: Type N.

2. Color: Standard gray.

H. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.

1. Type: Fine.

2.03 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa), deformed billet bars; galvanized.

B. Single Wythe Joint Reinforcement: 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 (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

C. Strap Anchors: Bent steel shapes, 1-1/2-inch (38 mm) width, 0.105-inch (2.7 mm) thick, 24-inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.

2.04 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

1. Masonry below grade and in contact with earth: Type S.

2. Exterior, loadbearing masonry: Type N.

3. Exterior, non-loadbearing masonry: Type N.

4. Interior, loadbearing masonry: Type N.

5. Interior, non-loadbearing masonry: Type O.

B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).

C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 HOT WEATHER REQUIREMENTS

A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.02 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. Mortar Joints: Concave.

3.03 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

B. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.04 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of the opening.

C. Place continuous joint reinforcement in the first and second joint below the top of walls.

D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.

E. Lap joint reinforcement ends minimum 6 inches (150 mm).

F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid.

G. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24inches vertically.

H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches (38 mm) with at least 5/8-inch (16 mm) mortar cover to the outside face of the anchor.

3.05 GROUTED COMPONENTS

A. Place and consolidate grout fill without displacing reinforcing.

B. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

END OF SECTION 04 20 00

SECTION 04 20 16 - REINFORCED UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes concrete masonry units, reinforcement, anchorage, and accessories.

1.2 RELATED SECTIONS

A. Section 03 30 00 – “Cast-in Place Concrete”: Steel reinforcing bars.

B. Section 04 05 03 – “Masonry Mortaring and Grouting”: Mortar and grout.

C. Section 05 50 00 – “Metal Fabrications”: Product requirements for loose steel lintels, and fabricated steel items.

D. Section 07 62 00, “Sheet Metal Flashing and Trim”: Product requirements for reglets for flashings for placement by this section.

E. Section 07 84 13 – “Penetration Firestopping”: Firestopping at penetrations of masonry work.

F. Section 07 90 00 – “Joint Protection”: Rod and sealant at control and expansion joints.

1.3 REFERENCES

A. ASTM International:

1. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
2. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
3. ASTM C90 - Standard Specification for Load bearing Concrete Masonry Units.
4. ASTM C129 - Standard Specification for Non-load bearing Concrete Masonry Units.
5. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
6. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.

B. The Masonry Society: TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.4 SUBMITTALS

A. Section 01 30 00 – Administrative Requirements: Submittal procedures.

B. Shop Drawings: Indicate bars sizes, spacing, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, accessories.

C. Product Data: Submit data for masonry units and fabricated wire reinforcement, wall ties, anchors and other accessories.

D. Design Data: Indicate required mortar strength, specified compressive strength of masonry, masonry unit assembly strength in each plane, supportive test data.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Product data and certificates that indicate percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.

G. Product data and certificates for products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification or in accordance with IBC and IBC Standards.

B. Fire Rated Wall Construction: Rating as indicated on Drawings.

C. Tested Rating: Determined in accordance with ASTM E119.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 MOCKUP

A. Retain accepted mockup as completed Work.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Hot Weather Requirements: TMS MSJC Specification.

1.11 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate masonry work with installation of window and door anchors.

PART 2 PRODUCTS

2.1 REINFORCED UNIT MASONRY ASSEMBLIES

A. Manufacturers:

1. Approved local manufacturer.

B. Recycled Materials: CMUs shall be manufactured with design mixtures that include cementitious materials other than Portland cement in CMU as follows:

1. Fly Ash: 25 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.

C. Regional Materials: Use CMU manufactured within 500 miles of Project site with aggregates and cement extracted, harvested, or recovered, within 500 miles of Project site.

2.2 COMPONENTS

A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; IBC Section 2103.12 grade N, Type I, normal weight

B. Fire Resistance Classification: In accordance with IBC Table 720.1 – Rated Fire Resistive Periods for various Walls and Partitions.

C. Concrete Masonry Unit Size and Shape: Nominal modular size (see plans). Furnish special units for 90-degree corners, bond beams, lintels, coved base, and bullnosed corners when required on drawings.

2.3 ACCESSORIES

A. Unless otherwise specified on drawings use the following accessories materials:

1. All steel reinforcement specified below or in drawings shall be coated steel at exterior walls and uncoated steel at interior walls.

2. Single Wythe Joint Reinforcement: ASTM A951; truss type; steel; 0.188-inch diameter side rods with 0.148-inch diameter cross ties.

3. Multiple Wythe Joint Reinforcement: ASTM A951; truss type; steel without moisture drip; 0.188-inch diameter side rods with 0.148-inch diameter cross ties.

4. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars.

5. Strap Anchors: bent steel shape, ASTM A153 hot dip galvanized.

6. Wall Ties: Corrugated formed sheet metal; ASTM A153 hot dip galvanized.

7. Wall Ties: ASTM A82; steel wire, adjustable; ASTM A153 hot dip galvanized.

8. Dovetail Anchors: Bent steel strap; ASTM A153 hot dip galvanized.

9. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15-inch embedment; galvanized finish at foundation walls.

10. Hot-Dipped Galvanizing: ASTM A153.

11. Mechanical Galvanizing: ASTM B695; Class 55.

12. Mortar and Grout: As specified in Section 04 05 03.

13. Preformed Control Joints: Neoprene material. Furnish with corner and tee accessories, heat fused joints.

14. Joint Filler: Closed cell polyurethane; oversized 50 percent to joint width; self-expanding; wide as shown on drawings by maximum lengths.

15. Building Paper: ASTM D226; Type I, No. 15 un-perforated asphalt felt.

16. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

17. Weeps: Preformed plastic tubes.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

C. Precast Concrete Lintels: type, size, as indicated on Drawings.

D. Steel Lintels: size as indicated on Drawings; hot-dip galvanized.

E. Recycled content of Reinforcing Steel and Accessory Materials: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 65 percent.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 – “Quality Requirements”: Testing, inspection and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – “Administrative Requirements”: Coordination and project conditions.

1. Verify field conditions are acceptable and are ready to receive work.

2. Verify items provided by other sections of work are properly sized and located.

B. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Furnish temporary bracing during installation of masonry work. Maintain bracing in-place until building structure provides permanent support.

3.3 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave

D. Placing And Bonding:

1. Lay solid masonry units in a full bed of mortar, with full head joints.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
4. Remove excess mortar as Work progresses.
5. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
6. Perform job site cutting of masonry units with proper tools to assure straight, clean, un-chipped edges. Prevent broken masonry unit corners or edges.
7. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, or bitumen damp-proofing is applied.
8. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings.
9. Isolate the top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler .

E. Joint Reinforcement And Anchorage:

1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches on each side of the opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.

5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

6. Embed anchors embedded in concrete or attached to structural steel members. Embed anchorages in every second block joint.

7. Reinforce stack bonded unit joint corners and intersections with strap anchors at 16 inches o.c.

F. Lintels:

1. Install loose steel or precast concrete lintels over openings.

2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.

3. Openings Up To 42 inches Wide: Place two No. 3 reinforcing bars 1 inch from bottom web.

4. Openings From 42 inches Up To 78 inches Wide: Place two, No. 5 reinforcing bars 1 inch from bottom web.

5. Openings Over 78 inches: Reinforce openings as indicated on Drawings.

6. Do not splice reinforcing bars.

7. Support and secure reinforcing bars from displacement.

8. Place and consolidate grout fill without displacing reinforcing.

9. Allow masonry lintels to attain specified strength before removing temporary supports.

10. Maintain minimum 4 to 6 inches bearing on each side of concrete opening, minimum 4 inches bearing on each side of steel opening and 6 to 8 inches bearing on each side of masonry opening.

G. Grouted Components:

1. Reinforce bond beams and pilasters as indicated on drawings.

2. Lap splices bar diameters required by code.

3. Support and secure reinforcing bars from displacement.

4. Place and consolidate grout fill without displacing reinforcing.

5. At bearing locations, fill masonry cores with grout for minimum 12 inches either side of opening.

H. Reinforced Masonry:

1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.

2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.

3. Splice reinforcement in accordance with Structural Drawings.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with TMS MSJC Specification.

I. Control And Expansion Joints:

1. Install control and expansion joints at the following maximum spacing, unless otherwise indicated on Drawings:
2. Exterior Walls: 20 feet on-center and within 24 inches on one side of each interior and exterior corner.
3. Interior Walls: 30 feet on-center.
4. At changes in wall height.
5. Do not continue horizontal joint reinforcement through control and expansion joints.
6. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
7. Size control joint in accordance with Section 07 90 00 for sealant performance.
8. Form expansion joint by omitting mortar and cutting unit to form open space.

J. Built-In Work:

1. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.

K. Cutting And Fitting:

1. Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

L. Parging:

1. When below grade masonry walls occurs and damp proofing or waterproofing coating or membrane is indicated on drawings or specified somewhere else parge as follows:
2. Dampen masonry walls prior to parging.
3. Scarify each parging coat to ensure full bond to subsequent coat.
4. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch.

M. Steel trowel for waterproofing and wood float for dampproofing, surface smooth and flat with maximum surface variation of 1/8 inch per ft.

1. Strike the top edge of parging at 45 degrees.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 – “Quality Requirements”: Tolerances.

B. Maximum Variation from Alignment of Columns: 1/4 inch.

C. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

I. Maximum Variation for Steel Reinforcement:

1. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
2. Plus or minus 1 inch when distance is between 8 and 24 inches (200 and 600 mm).
3. Plus or minus 1-1/4 inch when distance is greater than 24 inches (600 mm).
4. Plus or minus 2 inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 – “Quality Requirements” and 01 78 00 – “Closeout Submittals”: Field inspecting, testing, adjusting, and balancing.

3.6 CLEANING

A. Section 01 78 00 – "Closeout Submittals": Final 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.

3.7 PROTECTION OF FINISHED WORK

A. Section 01 78 00 – "Closeout Submittals": Requirements for protecting finished Work.

B. Protect exposed external corners subject to damage.

C. Protect the base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

3.8 SITE ENVIRONMENTAL PROCEDURES

A. Waste Management: As specified in Section 01 74 19 –"Waste Management" and as follows:

1. Mixing equipment: Minimize water used to wash equipment.

2. Broken, waste masonry units: May be used as non-structural fill with prior approval by Architect/Engineer.

3. Cured, crushed waste mortar: May be used as non-structural fill with prior approval by Architect/Engineer.

4. Coordinate with manufacturer for take-back program. Set aside scrap packaging to be returned to manufacturer for recycling into new product.

END OF SECTION 04 20 16

SECTION 05 12 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes structural steel.

B. This Section includes structural steel and architecturally exposed structural steel.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section 01 40 00- Quality Requirements for independent testing agency procedures and administrative requirements.

2. Division 5 Section 05 31 00 – Stainless Steel Plate Decking for field installation of shear connectors.

3. Division 5 Section 05 50 00 - Metal Fabrications for loose steel bearing plates and miscellaneous steel framing.

4. Division 9 Section 09 90 00 – Painting and Coating for surface preparation and priming requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

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D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.
2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Shear stud connectors.
5. Shop primers.
6. Non-shrink grout.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
   a. Category: Category I, conventional steel structures.
   b. Fabricator shall be registered with and approved by authorities having jurisdiction.

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

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
2. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."
3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
4. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
5. AISC's "Seismic Provisions for Structural Steel Buildings."
6. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the 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 projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Mockups: Prior to installing architecturally exposed structural steel, construct mockups for each form of construction and finish required to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.

2. Notify Architect one week in advance of the dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship of steel surfaces and welded and bolted connections.

a. Coordinate finish painting requirements of mockups with Division 9 Section "Painting and Coating."

4. Obtain Architect's approval of mockups before start of final unit of Work.

5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

a. When directed, demolish and remove mockups from Project site.

b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

B. Shop prime and paint all structural steel members per Section 09 90 00 Painting and Coating. Touch-up paint as necessary after erection is completed and before beginning installation of any steel frame mounted supports or hangers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As follows:

1. Carbon Steel: ASTM A 36.

2. High-Strength, Low-Alloy Columbium-Vanadium Steel: ASTM A 572, Grade 50.

3. High-Strength, Low-Alloy Structural Steel: ASTM A 588, Grade 50, corrosion resistant.

B. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

C. Hot-Formed Structural Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Type E or S, Grade B. Weight class and finish as indicated on drawings.

E. Carbon-Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel.

F. High-Strength Steel Castings: ASTM A 148, Grade 80-50.

G. Shear Connectors: ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.

H. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Un-headed Rods: ASTM A 36 (ASTM A 36M).

2. Un-headed Rods: ASTM A 572, Grade 50 (ASTM A 572M, Grade 345).

3. Un-headed Bolts: ASTM A 687, high strength.

4. Headed Bolts: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; and carbon-steel nuts.

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5. Headed Bolts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

6. Headed Bolts: ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

7. Washers: ASTM A 36 (ASTM A 36M).

I. Non-high Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

J. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

K. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated.

L. Welding Electrodes: Comply with AWS requirements.

M. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than the following:

1. W-Shapes: **60** percent.

2. Channels, Angles**, M, S**-Shapes: **60** percent.

3. Plate and Bar: **25** percent.

4. Cold-Formed Hollow Structural Sections: **25** percent.

5. Steel Pipe: **25** percent.

6. All Other Steel Materials: **25** percent.

2.2 **PRIMER** (when not in conflict with intumescent paint)

A. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

B. Primer: SSPC-Paint 25; red iron oxide, zinc oxide, raw linseed oil and alkyd primer.

C. Primer: SSPC-Paint 23, latex primer.

D. Primer: SSPC-Paint 15, Type I, red oxide.

E. Primer: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.

F. Primer: Non-asphaltic primer complying with SSPC's "Painting System Guide No. 7.00."

G. Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements of FS TT-P-664.

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H. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Metallic, Shrinkage-Resistant Grout: Premixed, factory-packaged, ferrous aggregate grout, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

C. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

1. Camber structural steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

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E. 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 printed instructions.

F. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

G. Welded Door Frames: Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches (250 mm) o.c., unless otherwise indicated.

H. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. Shop install and tighten non-high strength bolts, except where high-strength bolts are indicated.

B. Shop-install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Shop-install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.

2. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.

3. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

4. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed-on fireproofing.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

C. Above and below remove loose rust, mill scale, and paint; above by hand and below by power tools. Above is the minimum surface preparation accepted by AISC for painted steel.

1. SSPC-SP 2 "Hand Tool Cleaning."
2. SSPC-SP 3 "Power Tool Cleaning."
3. SSPC-SP 7 "Brush-Off Blast Cleaning."
4. SSPC-SP 8 "Pickling."
5. SSPC-SP 10 "Near-White Blast Cleaning."
6. SSPC-SP 11 "Power Tool Cleaning to Bare Metal."

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

E. Painting: Apply a 1-coat, non-asphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

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1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Shop-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

F. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

4. Ultrasonic Inspection: ASTM E 164.

G. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection unless authorized in writing by the Architect and Structural Engineer.

H. If thermal field cut is authorized by Architect / Structural Engineer, finish sections thermally cut during erection equal to a sheared appearance.

I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten non-high strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.5 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC specifications referenced in this Section, manufacturer's recommendations, and requirements of the testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

F. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Liquid Penetrant Inspection: ASTM E 165.

2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."

4. Ultrasonic Inspection: ASTM E 164.

G. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.7 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 5 mils (0.038 mm).

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes load bearing formed steel stud exterior wall, and interior wall, framing; and formed steel C-joists, ceiling joists, steel stud header wall framing, and bracing supported from roof structure, deep leg track (capture track) for interior non-load-bearing steel stud partitions.

1.2 RELATED SECTIONS

A. Section 07 21 00 - Board and Batt Insulation: Insulation within framing members.

B. Section 07 90 00 - Joint Sealers.

C. Section 09 22 16 - Non-Structural Metal Framing

D. Section 09 29 00 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

1.3 REFERENCES

A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)

B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.

C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galv-annealed) by the Hot-Dip Process; 2004a.

D. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability; 2004b.

E. ASTM C 955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2003.

F. ASTM C 1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2004.

G. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2004.

H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.4 SUBMITTALS

A. Section 01 30 00 –Submittal Procedures.

B. Shop Drawings:

1. Indicate component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of related Work.
2. Indicate stud, floor joist, ceiling joist and roof joist, and layout.
3. Describe method for securing studs to tracks and for bolted framing connections.
4. Submit calculations for loadings and stresses of specially fabricated framing, under Professional engineer's seal.

C. Product Data: Submit data on standard framing members; describe materials and finish, product criteria.

D. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

E. Mill Certifications: Submit mill certifications for steel delivered to site. Certify steel bare metal thickness in 0.001-inch (0.025 mm), yield strength, tensile strength, total elongation in 2-inch (50 mm) or 8-inch (200 mm) gauge length, chemical analysis, and galvanized coating thickness.

1.5 QUALITY ASSURANCE

A. Calculate structural properties of framing members in accordance with AISI SG-973 Specification for Design of Cold-Formed Steel Structural Members.

B. Furnish framing materials in accordance with SSMA - Product Technical Information.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience.

B. Current member of Steel Stud Manufacturers Association.

C. Installer: Company specializing in performing Work of this section with minimum five years documented experience or approved by manufacturer.

D. Design structural elements under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Puerto Rico.

E. Form, fabricate, provide, and connect components in accordance with NAAMM ML/SFA 540 - Lightweight Steel Framing Systems Manual.

F. Qualifications for Welding Work: Qualify welding operators in accordance with AWS Standard Qualification Procedures. Provide certification that welders employed in work have satisfactorily passed AWS qualification tests within the previous 12 months.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Clark Dietrich Building Systems: (800)-543-7140.
2. Marino / Ware: (800)-627-4661
3. Nuconsteel: (940)-891-3050
4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Interior and Exterior Load-Bearing Studs: ASTM A 653 and ASTM C 955; galvanized sheet steel, channel shaped, punched for utility access, depth and gage as indicated on Drawings.

1. 600SN16 – 6-inch studs, 16 gauge.

B. Interior and Exterior Load-Bearing Cee-Joists: ASTM A 653 Structural Quality; galvanized sheet steel, channel shaped, depth and gage as indicated on Drawings.

1. 400SJ18 – 4-inch joists, 18 gauge.
2. 600SJ16 – 6-inch joists, 16 gauge.

C. Partition Floor Tracks and Runners: ASTM A 653 and ASTM C 955; galvanized sheet steel, channel shaped; same depth and gage as studs, tight fit, solid web.

1. 18 Gauge Studs: CR18 x stud size.
2. 16 Gauge Studs: CR16 x stud size.

D. Capture Track: Partition Deep Leg Track at Roof Deck or Structure for Non-load-Bearing Steel Stud Partitions to provide vertical travel as indicated:

1. ASTM A 653 and ASTM C 955; galvanized sheet steel, channel shaped; solid web and 20 Gage Studs, CR18 x stud depth x 4-inch leg. (designed for 5 pounds per square foot uniform load perpendicular to partition)

E. Load-Bearing Wall Furring and Partition Bracing: ASTM A 653 and ASTM C 955, galvanized sheet steel.

F. Studs:

1. 400SN20 – 4-inch studs, 20 gauge.
2. 400SN18 – 4-inch studs, 18 gauge.

G. Cold-Rolled Channels: ¾ inch x ½ inch and 1-1/2-inch x 17/32 inch.

H. Clip Angles: 2 inches x 2 inches x 16 gage x ¼ inch less than stud width or Bridge Clip by the Steel Network (888) 474-4876.

I. Framing Attachment Angles: ASTM A 653 Structural Quality; galvanized sheet steel, size, shape and configuration as indicated on Drawings, 14 gauge, unless indicated otherwise on Drawings.

J. Ceiling Joists and Runners: ASTM A 653 and ASTM C 955; galvanized sheet steel, cee shaped.

1. 600SJ20 – 6-inch joists, 20 gauge.

2. 600CR20 – 6-inch runner track, 20 gauge.

K. Flat Metal Straps and Plates: ASTM A 653; galvanized sheet steel, gage, shape, and configuration as indicated on Drawings.

L. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.3 FASTENERS

A. Framing to Framing: ASTM C 954; 5/8-inch Type S-12 low profile head corrosion resistant self-drilling self-tapping steel screws.

B. Framing to Attachment Angle Fasteners: #12 diameter pan head corrosion resistant self-drilling self-tapping steel screw.

C. Wall Floor Track Anchorage Device: Carbon steel wedge type expansion anchor; minimum 3/8-inch diameter x minimum 1-1/2-inch embedment.

D. Kwik Bolt KB II 38-3, by Hilti, Tulsa, OK (800) 879-8000.

E. Thrubolt WS-3822, by ITW Ramset/Red Head, Wood Dale, IL (708) 350-1558.

F. Wall Furring to Concrete or Masonry Wall Fasteners: Hex head sleeve anchors; minimum ¼ inch diameter x minimum 1-1/8-inch embedment.

G. Sleeve Anchor HX 5/16X2-1/2, by Hilti, Tulsa, OK (800) 879-8000.

H. Dyanbolt HN-1413, by ITW Ramset/Redhead, Wood Dale, IL (708) 350-1558.

I. Furring Channel to Masonry or Concrete Surface Fasteners: Low velocity powder-actuated drive pins of size to suit application.

J. Welding: ASW D1.3.

K. Wood Furring, Blocking, and Plywood, Attached to Farming Fasteners: Specified in Section 06100.

2.4 FINISHES

A. Galvanizing: G90 coating class.

B. Primer: SSPC Paint 20, Type I, touch up for galvanized surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions and adjacent areas where products will be installed and verify that conditions conform to product manufacturer's requirements. Verify that building framing components are ready to receive work. Verify that rough utilities are in place and located where required. Do not proceed until unsatisfactory conditions have been corrected.

B. The beginning of erection indicates acceptance of existing conditions.

3.2 INSTALLATION – STUD FRAMING

A. Install studs and fasteners in accordance with manufacturer's published instructions and where gypsum board is attached to studs, install studs in accordance with GA-201 and GA-216.

B. Metal Stud Spacing: 24 inches on center, maximum.

C. Align stud web openings horizontally.

D. Construct corners using a minimum of three studs.

E. Place studs as indicated on Drawings, minimum 2 inches from abutting walls.

F. Erect studs one-piece full length. Splicing of studs not permitted.

G. Erect studs, brace, and reinforce to develop full strength to meet design requirements.

H. Install headers at partition openings using load-bearing C joists.

I. Install framing between studs for attachment of mechanical and electrical items.

J. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

K. Install intermediate studs above and below openings to match wall stud spacing.

L. Fasten studs adjacent to door and window frames, partition intersections, and corners to top and bottom runner flanges in double-stud fashion with metal lock fastener tools.

M. Securely fasten studs to jamb and head anchor clips of door and borrowed light frames.

N. Place horizontally a cut-to length section of runner with web-flange bent at each end, fasten with minimum one screw per flange.

O. Position a cut-to-length stud (extending to top runner) at vertical panel joints over door frame header.

P. Install bridging for stud partitions over 8 feet high at mid-height with 1-1/2 inch rolled channels through studs and screw attach in place using clip angels. Lap channels by nesting one inside the other to a depth of at least 8 inches and wire tie together.

Q. Blocking: Screw attach wood blocking between studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, and hardware.

R. Touch up field welds and damaged galvanized surfaces with primer.

S. Fastening: Fasten framing in accordance with manufacturer's published instruction and schedule below, unless indicated otherwise on Drawings.

3.3 MINIMUM CONNECTION FASTENERS

A. Floor Track to Concrete: 1-Anchor at 24 inches on center

B. Partition Stud to Floor Track: 1-Screw each side at flange.

C. Stud Web to Stud Web: 2-Screws

D. Plates and Straps to Studs: 2-Screws

E. Lateral Bracing to Partition Stud Using clip Angles, 2-Screws to stud and 2-Screws to cold rolled channel.

F. Runner to Header: 1-Screw at 16 inches on center, maximum 6 inches from each end.

G. Welded Connections: Indicated on Drawings

3.4 INSTALLATION – JOIST FRAMING

A. Install joists and fasteners in accordance with manufacturer's published instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at locations and spacing as indicated on Drawings.

D. Touch-up field welds and damaged galvanized surfaces with primer.

E. Fastening: Indicated on Drawings.

3.5 INSTALLATION – CEILING JOISTS

A. Install joists and fasteners in accordance with manufacturer's published instructions and, where gypsum board is attached to joists; install joists in accordance with GA-201 and GA-216.

B. Ceiling Joist Spacing: 16 inches on center beginning from center of room.

C. Install joists in the direction of shortest span, parallel and level, with lateral bracing and bridging.

D. Install joists in one-piece full length. Splicing of joists not permitted.

E. Install perimeter joist runner track sized to match joists. Attach joist runner track to wall framing with minimum 2 screws per stud and at corners and ends.

F. Attach joist ends to joist runner tracks with minimum 1 screw each side at each flange.

G. Install bridging at 48 inches on center beginning from center of room with 1-1/2 inch rolled channels screw attached to joists.

3.6 INSTALLATION –FURRING

A. Furring Channels: Attach vertically spaced at maximum 24 inches on center, to masonry and concrete surfaces with specified powder driven fasteners staggered 24 inches on center on opposite flanges.

B. Wall Furring:

1. Secure top and bottom runners to structure.

2. Space metal furring at maximum 16 inches on center.

3.7 CONSTRUCTION

A. Coordinate and interface with Other Work:

1. Coordinate erection of studs with hollow metal door frames and overhead coiling door frames.

2. Coordinate installation of anchors, supports, and blocking for mechanical, electrical, and building accessory items installed within framing.

3.8 FIELD QUALITY CONTROL

A. Inspect metal framing erection, placement, spacing, fasteners, welds, and connections to building.

B. Correct deficiencies in Work which inspection indicates are not in compliance with Contract Documents.

3.9 SITE ENVIRONMENTAL PROCEDURES

A. Waste Management: As specified in Section 01 74 19 – Construction Waste Management.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel, aluminum, and other metallic items.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications and anchors in concrete.

B. Section 05 52 13 - Pipe and Tube Railings

C. Section 09 90 00 - Paints and Coatings: Paint finish and protective coatings.

1.3 REFERENCES

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements.

B. ASTM A 36 - Standard Specification for Carbon Structural Steel.

C. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

E. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

F. ASTM A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

G. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

H. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

I. ASTM B 177 - Standard Guide for Engineering Chromium Electroplating.

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society.

K. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings.

L. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings.

M. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings.

1.4 SUBMITTALS

A. See Section 01 30 00 Administrative Requirements.

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B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.5 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Puerto Rico.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A 36.

B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.

C. Plates: ASTM A 283.

D. Pipe: ASTM A 53, Grade B Schedule 40, black finish.

E. Bolts, Nuts, and Washers: ASTM A 325, Type 1, galvanized to ASTM A 153 where galvanized components are connected.

F. Welding Materials: AWS D1.1; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Fit and shop assemble items in the largest practical sections, for delivery to site.

1. Fabricate items with joints tightly fitted and secured.

2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

3. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

A. Utility Equipment Enclosure: Galvanized steel ASTM A36 sheet, tubular steel columns and sections, miscellaneous channel sections and angles, and plates, with 33% open hole pattern galvanized perforated metal panels with continuous U-Edging (1/8" Opening x 1" Width) as indicated in drawings.

B. Suspended Equipment Platforms: Galvanized steel ASTM A36 sheet, tubular steel columns, W-shape beams, miscellaneous channel sections and angles, and plates, with galvanized diamond plate panels or slab on metal deck as indicated in drawings.

C. Ladders: Steel; in compliance with ANSI A14.3 and OSHA requirements; with mounting brackets and attachments; prime paint finish.

D. Side Rails: 3/8 x 2 inches (9 x 50 mm) members spaced at 20 inches (500 mm).

E. Rungs: 2 ¼" Serrated Steel Tread.

F. Space rungs 7 inches (175 mm) from the wall surface.

G. Telescopic Steel Columns: Steel pipe; prime paint finish.

H. Bumper Posts and Guard Rails: As detailed; prime paint finish.

I. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.

J. Joist and Equipment Hangers: Strap anchors, fabricated with 16 gage steel; galvanized finish.

K. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

L. Lintels: As detailed; prime paint finish.

M. Door Frames for Overhead Door Openings, and Wall Openings: Channel sections; prime paint finish.

N. Equipment Suspension Members: Steel channel sections; prime paint finish.

2.4 FINISHES - STEEL

A. Prime paint all steel items.

1. Exceptions: Galvanize items to be embedded in concrete or masonry and items specified for other finish.

2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, items will be encased in concrete, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Structural Steel Member Galvanizing: Galvanize after fabrication to ASTM A 123 requirements.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A 123 requirements.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval before making un-scheduled field cutting or adjustments.

F. After erection is complete, prime welds, abrasions, and surfaces that are not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION 05 50 00

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: Provide technical data on wood preservative materials and application instructions.

B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

C. Environmental Product Declaration including EPD's, product comparison documentation, third-party certification documentation, life cycle analysis documentation and sustainable forestry certification documentation (Forest Stewardship Council FSC, Sustainable Forestry Initiative SFI).

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 any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Provide sustainably harvested wood; see Section 01 60 00 - Product Requirements for requirements.

2.2 DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.

2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

A. Backer Panels for Casework, Equipment, and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Other Applications:

1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.

2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.

3. Other Locations: PS 1, C-D Plugged or better.

2.4 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications:

1. Fire-Retardant Treated Wood: Mark each piece of wood with manufacturer's stamp indicating compliance with specified requirements.

2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

END OF SECTION – 06 10 00

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

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. Plastic-laminate veneer cabinets.
2. Solid-surfacing-material countertops and end panels.
3. Shop finishing of interior woodwork.

B. Related Sections include the following:

1. Section 01 81 16 “VOC Limits for Adhesives, Sealants, and Paints, and Coatings” for wood and plastic laminate adhesives, and wood coatings and sealants.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
3. Section 09 30 00 “Tiling” for wall finishing above countertop backsplash.
4. Section 22 11 16 “Water Distribution Piping” for providing openings to pass-thru plumbing lines.
5. Section 22 13 16 “Drainage And Vent Piping” “Water Distribution Piping” for providing openings to pass-thru plumbing lines.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material cabinet hardware and accessories and finishing materials and processes.

1. Product Data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. Product Data for adhesives, including printed statement of VOC content.
3. Product Data for each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.

4. Product Data for each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.

5. Product Data for products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content

    a. Include statement indicating costs for each product having recycled content.

6. Quality Standard Certificates certifying that wood products comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork for construction, finishes, and installation.

7. Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.

4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.

2. Plastic laminates.

3. PVC edge material.

4. Thermoset decorative panels.

5. Solid-surfacing materials.

D. Samples for Verification:

1. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.

E. Product Certificates: For each type of product, signed by product manufacturer.

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1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in service performance.

B. Installer Qualifications: Fabricator of products.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

D. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions".

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and maximum relative humidity 65 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of [AWI's] [WI's] quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Cherry, flat cut with Mahogany stain.

C. Wood Products: Comply with the following:

1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

2. Particleboard: ANSI A208.1, M-2-Exterior Glue.

3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesives containing no urea formaldehyde.

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Formica Corporation.

b. Nevamar Company, LLC; Decorative Products Div.

c. Wilsonart International; Div. of Premark International, Inc.

2. Colors and Patterns: As indicated on drawings, or Match Architect's samples.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

C. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.

2. Contact Adhesive: 200 g/L.

D. Adhesive for Bonding Plastic Laminate: Un-pigmented contact cement.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

D. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.

2. Vertical Surfaces: Grade HGS.

3. Edges: Grade HGS.

D. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.

b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels.

3. Drawer Bottoms: Thermoset decorative panels.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.

G. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.6 COUNTERTOPS

A. Quartz Sheet:

1. Product: Technistone.
2. Composition: Quartz aggregate, resin, and color pigments formed into flat slabs.
3. Anti-microbial protection: Microban by Microban International, Inc., integral to sheet.
4. Color: Harmonia Yosemite
5. Thickness: ¾" (20 mm).
6. Physical characteristics:
   a. Static coefficient of friction: 1.02 dry, 0.51 wet, tested to ASTM C1028.
   b. Water absorption: Maximum 0.03 percent, tested to ASTM C97.
   c. Compressive strength: Minimum 29,000 psi, tested to ASTM C170.
   d. Bond strength: Minimum 210 psi, tested to ASTM C482.
   e. Modulus of rupture: Minimum 6300 psi, tested to ASTM C99.
   f. Flexural strength: Minimum 5800 psi, tested to ASTM C880.
   g. Breaking strength: Minimum 480 lbf, tested to ASTM C648.
   h. Stain resistance: Not affected by 10 percent hydrochloric acid or 10 percent KOH, tested to ASTM C650.
   i. Thermal shock resistance: Pass 5 cycles, tested to ASTM C484.
   j. Abrasive index: 65-Ha = 25, tested to ASTM C241.
   k. Thermal expansion: 1.670 x 10-5 in/in/deg F, tested to ASTM C531.
   l. Deicing resistance: Rating of 0, tested to ASTM C672/C672M.
   m. Flame spread rating: Class 1, tested to ASTM E84.

B. ACCESSORIES

1. Adhesive: Type recommended by quartz manufacturer.
2. Joint Sealer:
   1. Latisil Tile and Stone Sealant by Laticrete International, Inc.
   2. Color: To be selected from manufacturer's full color range.

C. FABRICATION

1. Cut quartz panels accurately to required shapes and dimensions.
2. Bevel exposed edges.

3. Fabricate with hairline joints.

4. Cut holes for sinks and faucets.

2.7 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back priming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

E. Transparent Finish:

1. Grade: Custom.

2. AWI Finish System: Conversion varnish.

3. Staining: Match Architect's sample.

4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.

5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTMD 523.

PART 3 EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Do not install if relative humidity is over 65%.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless covered by trim.

1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately and consistently aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

2. Maintain veneer sequence matching of cabinets with transparent finish.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.

4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23

07 21 00 - RIGID BOARD AND BATT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid board and batt type wall insulation for thermal protection as part of wall assemblies.

B. Related Sections:

1. Section 01 61 16 – Volatile Organic Compound (VOC) Content Restrictions.
2. Section 06 10 53: Miscellaneous Rough Carpentry (framing)
3. Section 07 84 13: Penetration Firestopping.
4. Section 09 22 16: Non-Structural Metal Framing
5. Section 09 29 00: Gypsum board Assemblies
6. Section 09 81 00: Acoustic Insulation
7. Section 23 07 11: Mechanical Insulation

1.2 REFERENCES

A. ASTM C553 – 13 (2019) - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

B. ASTM C1320 - 20 - Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction; 2020

C. ASTM E 84-20 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

D. ASTM E 136-19 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C; 2019.

1.3 SUBMITTALS

A. Comply with submittal procedures specified in Section 01 30 00.

B. Product data: Manufacturer's specifications and installation instructions for each type of application of insulation board and fasteners.

C. Samples:

1. Submit 5-inch x 9-inch sample(s) of each board and batt type required.
2. Submit sample(s) of each fastener type required.

D. Shop drawings: Wall framing design plan and fastening patterns.

E. Certificates: Manufacturer's certification that materials meet specification requirements.

A. Product Data for recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.

B. Product Data for insulation on the building interior, documentation from an independent testing agency indicating compliance with the Indoor Advantage Gold by SCS. Include statement of VOC and Formaldehyde content.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation possessing the surface burning characteristics indicated, determined by testing identical products in accordance with test method ASTM E 84.

C. Testing and Labeling: Shall be by Underwriters Laboratories or another testing and labeling agency acceptable to authorities having jurisdiction. All insulation shall be identified with appropriate markings from the applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with general requirements specified in Section 01 60 00.

B. Protect insulation materials from physical damage and from deterioration by soiling, and other sources. Store inside and in a dry location, or wipe surface dry the extruded polystyrene insulation before installing. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect foam plastic insulation as follows:

1. Do not expose to sunlight, except to the extent necessary for a period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to the Project site before installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

4. When installing black/dark (non-white) tapes and/or waterproofing/air barrier membranes over insulation, avoid prolonged sun exposure of such surfaces. Provide daily final finish covering or temporary white opaque covering over black/dark (non-white) surfaces to avoid possible solar heat damage.

1.6 PROJECT CONDITIONS

A. Comply with building code and / or insurance underwriter’s requirements applicable for products of this Section.

B. Do not install insulation when insulation and / or framing are wet.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers and Products: Mineral Wool Batt and Rigid Board Acoustic and Fire Insulation:

1. Knauf Eco Batt insulation. www.knaufinsulation.us.

2. Roxulsafe fire and acoustic insulation. www.roxul.com.

3. Johns Manville Sound Control and Thermal Control Batt Insulation.

2.2 MATERIALS

A. Mineral-Wool Blanket Insulation

1. Unfaced, Mineral-Wool Batt and Rigid Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Sustainability Requirements: Provide Mineral-Wool Batt and Rigid Insulation: insulation as follows:

1. See 016116 – Volatile Organic Compound (VOC) Content Restrictions

2. Formaldehyde Free: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

3. Environmental Product Declaration: Provide an EPD from the manufacturer for each individual insulation material and product.

4. Health Product Declaration: (HPD) : Provide a third-party HPD certification from the manufacturer for each individual insulation material and product.

2.3 ACCESSORIES

A. Adhesive:

1. Type recommended by insulation manufacturer.

2. Interior adhesives: Maximum volatile organic compound (VOC) content: 30 grams per liter.

B. Impale Fasteners:

1. Staples or Nails: ASTM F1667, zinc coated, size and type best suited for purpose.

2. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 50 mm (two inches) in diameter.

3. Impaling Pins: Steel pins with head not less than 50 mm (two inches) in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

C. Metal Clips: Galvanized steel, L-shaped, 2 inches long.

D. Tape:

1. Minimum 2 inches wide, pressure sensitive, waterproof adhesive on one face.

2. Perm rating of not more than 0.50.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing for suitability to receive insulation. Verify that substrate is dry, straight, clean and free of foreign material that will damage insulation or impede installation. Verify that vapor barrier is in place.

B. Start of installation indicates installer accepts conditions of existing framing surfaces and substrates.

3.2 APPLICATION / INSTALLATION

A. Install specified wall insulation panels using approved mechanical fasteners and adhesives in accordance with manufacturer's latest written instructions and as required by governing codes and architect's instructions.

B. Install tight board to board joints to assure proper edge contact and thermal performance.

3.3 INSTALLATION - GENERAL

A. On the interior face of solid masonry and concrete walls, beams, beam soffits, underside of floors, and to the face of studs for interior wall finish where shown.

B. Install insulation with the vapor barrier facing the exterior, unless specified otherwise.

C. Install rigid insulating units with joints close and flush, in regular courses and with cross joints broken.

D. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

E. Bond to solid vertical surfaces with adhesive as recommended by insulation manufacturer. Fill joints with adhesive cement.

F. Use impaling pins for attachment to the underside of horizontal surfaces. Space fastenings as required to hold insulation in place and prevent sagging.

G. Fasten board insulation to face of studs with screws, nails or staples. Space fastenings not more than 12 inches apart. Stagger fasteners at joints of boards. Install at each corner.

3.4 CLEANING / PROTECTION

A. Remove trash and construction debris from insulation and / or framing surfaces prior to application.

B. Do not leave installed insulation exposed to weather, long term. Cover with the exterior cladding within 10 days after installation

1. Remove and replace damaged installed insulation with new insulation.

2. Allow wet insulation to air-dry prior to installing the wall cladding.

END OF SECTION 07 21 00

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 072423 – DIRECT-APPLIED EXTERIOR FINISH SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Materials and installation of non-insulated exterior finish system for direct application to substrates at soffits and weather-protected areas.

1.2 RELATED SECTIONS

A. 01 81 16 - VOC Limits for Adhesives, Sealants, Paints, and Coatings.

B. 07 62 00 – Flashing and Sheet Metal Trim.

C. 07 92 00 – Joint Sealants.

D. 09 21 16 – Gypsum Board Assemblies.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. C 150: Specification for Portland Cement; latest edition.
2. C 297: Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; latest edition.
3. C 1177: Specification for Glass Mat Gypsum for Use as Sheathing; latest edition.
4. D 1784: Specification for Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; latest edition.
5. D 3273: Test for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; latest edition.
6. E 84: Test Method for Surface Burning Characteristics of Building Materials; latest edition.
7. E 2486: Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS) ; latest edition.
8. G 153: Recommended Practice for Operating Light-and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials; latest edition.

B. Gypsum Association:

1. 1.GA-600 Fire Resistance Design Manual; latest edition.
2. 2.GA-253 Application of Gypsum Sheathing ; latest edition.
3. 3.GA-254 Fire Resistant Gypsum Sheathing; latest edition.

C. International Code Council Evaluation Service (ICC-ES)

1. AC 59, Acceptance Criteria for Direct-Applied Exterior Finish Systems (DEFS)

1.4 SUBMITTALS

A. See Section 01 30 00 for submittal procedures.

B. Product Data: Manufacturer's specifications, details, installation instructions and product data.

1. Manufacturer's code compliance report.
2. Manufacturer's standard warranty.
3. Manufacturer's certificate of compliance with EIMA standards.
4. Manufacturer’s report indicating satisfactory results of required testing procedures.

C. Installer's qualifications documentation.

D. Samples: For selection of finish coat colors and textures.

1.5 QUALITY ASSURANCE

A. EIFS Manufacturer Qualifications:

1. Member in good standing of the EIFS Industry Members Association (EIMA).
2. System manufacturer for a minimum of twenty (20) years.
3. Manufacturer's wall assembly listed in Gypsum Association Fire Resistance Design Manual.

B. Installer Qualifications:

1. Engaged in application of EIFS for a minimum of three (3) years.
2. Knowledgeable in the proper use and handling of the materials specified and listed by the material manufacturer as having attended manufacturer-provided continuing education.
3. Employ skilled mechanics who are experienced and knowledgeable in EIFS application, and familiar with the requirements of the specified work.
4. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.
5. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with EIFS manufacturer's published specifications and details and the project plans and specifications.

C. Inspections: Visual and documented inspections shall coincide with Pre-construction meeting, moisture barrier application, foam application, and basecoat application. Provide inspections by proprietary EIFS product representative.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in their original sealed containers bearing manufacturer's name and product identification.

B. Protect coatings (pail products) from freezing and temperatures in excess of 90 degrees F. Store away from direct sunlight.

C. Protect Portland cement-based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's 15-year labor and material warranty.

1.8 COORDINATION SCHEDULING

A. Install flashings, copings and sealant immediately after installation of the system and when coatings are dry

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Direct-Applied Exterior Finish System

1. Provide components from single source manufacturer or approved supplier.
2. Manufacturers
    a. Sto Corporation; www.stocorp.com (basis of design).
    b. Dryvit Systems, Inc.; www.dryvit.com
    c. Parex USA, Inc.; www.parex.com.
    d. BASF Senergy Wall Systems; www.senergy.basf.com
    e. Substitutions: refer to Section 01 60 00.

B. Accessories:

1. Provide metal beads, starter tracks, screeds, reveals and other components as indicated in the drawings or as required for a complete systems recommendation
2. Furnish accessories from the EIFS system manufacturer or a single manufacturer or supplier approved by the EIFS system manufacturer.

2.2 MATERIALS

A. Air and Water-Resistive Barrier: Either sheet-type material that constitutes an air retarder, but which is vapor permeable or fluid applied type as provided by EIFS system manufacturer and applicator as part of a single source warranted installation. Refer to Section 076200 – Weather Barriers.

B. Base Coat: One-component polymer modified cement-based factory blend base coat with less than 33 % Portland cement content by weight.

C. Reinforcing Mesh: Nominal 4.5 oz/sq yd, symmetrical, interlaced open-weave glass fiber fabric made with minimum 20 percent by weight alkaline resistant coating for compatibility with EIFS coating materials; capable of achieving EIMA Standard Impact Classification.

D. Waterproof Base Coat: Two component fiber reinforced acrylic based waterproof base coat mixed with Portland cement. Watertight Coat is an acceptable substitute.

1. Use on horizontal and sloped surfaces that project more than 2 inches from face of wall.

E. Primer: Required as part of the system: Acrylic based tinted primer.

F. Finish Coat: Silicone enhance textured wall coating with graded marble aggregate.

1. Color: As indicated on drawings.
2. Marble Color: As indicated on drawings.

G. Water: Clean and potable.

H. Joint Sealant: Non-sag polyurethane sealant that has 50 percent elongation after conditioning, when tested in accordance with ASTM C 1382; compatible with EIFS materials and with compatible backer rod. Refer to Section 07 92 00.

PART 3 - EXECUTION

3.1 COORDINATION

A. EIFS installer shall provide coordination with installers of related and adjacent materials to ensure that:

1. Finish grading of site is such that EIFS terminates above finished grade a minimum of 8 inches (203 mm) or as required by code.
2. Penetrations through wall are protected from weather prior to installation of windows, doors, and other closures.
3. Sill flashing is provided at all openings.
4. Head flashing is installed immediately after windows and doors are installed.
5. Diverter flashings are installed wherever water can enter the wall assembly to direct water to the exterior.
6. Copings and related sealant are installed immediately after installation of EIFS when EIFS coatings are dry.
7. Penetrations are attached using fasteners through EIFS to structural support, with watertight seal.

3.2 INSTALLATION

A. Install finish system in accordance with manufacturer's published instructions.

B. Apply all materials listed in Materials section of this specification in the order of progression as listed in the Materials section.

C. Use Base Coat for general application. Substitute Waterproof Base Coat as needed according to manufacturer's recommendations or as directed in the Materials Article above.

D. Provide minimum 3/4-inch-wide expansion joints through EIFS where moving joints exist in the substrate or supporting construction, where EIFS adjoins dissimilar construction or materials, at changes in building height, and at floor lines in multi-level frame construction.

E. Provide minimum 1/2-inch-wide sealant joints at all penetrations through the EIFS (windows, doors, etc.).

F. Provide joints with secondary moisture protection and drain to the exterior.

3.3 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.

B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION 07 24 23

07 52 00 - SBS MODIFIED BITUMEN ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. The Work generally involves providing a two-ply reinforced S.B.S. Modified membrane torched. The base sheet will be mechanically fastened on a Lightweight Insulating Concrete deck and the cap sheet torched complete with related flashings and performing such incidental or other work as may be necessitated by these operations and called for by the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06 10 0: Rough Carpentry

B. Section 07 62 00: Sheet Metal Flashing and Trim

C. Section 07 71 00: Roof Specialties

D. Section 07 92 00: Joint Sealers

E. Section 09 00 00 Cementitious Gypsum Board

1.3 REFERENCES

A. ANSI/ASTM D41 - Asphalt Primer Used in Roofing, Damproofing, and Waterproofing.

B. ANSI/ASTM D312 - Asphalt Used in Roofing.

C. ANSI/ASTM D2178 - Asphalt Impregnated Glass Mat Used in Roofing and Waterproofing.

D. Factory Mutual (FM) Engineering Corporation - Roof Assembly Classifications.

E. National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual.

F. Underwriters Laboratories (UL) - Fire Hazard Classifications.

G. Sheet Metal and Air-Conditioning Contractors National Association, Inc. (SMACNA).

H. CGSB 37GP56M Classification: Type 2, Class C, Grade 1.

I. Metro Dade County - Building Code and Compliance

1.4 SYSTEM DESCRIPTION

A. System Sopra-fix 32f 48 Description:

1. Two ply - base and top - S.B.S. Modified Membrane - Torched / Mechanical fastened Lightweight Concrete Decking

1.5 SUBMITTALS

A. Manufacturer's product data sheets and installation instructions on all materials proposed for use.

CONSTRUCTION GROUP, LLC

B. Specimen copy of the manufacturer's standard roofing warranty.

C. U. L. and F. M. compliance data (Contact Soprema's Technical Department (1-800-356-3521) for additional information).

D. Shop Drawings indicating setting plan for tapered insulation (when applicable).

E. Submit two 8 x10 inch samples of membrane illustrating the color and thickness to be used.

F. Submit a copy of the manufacturer's installation instructions.

1.6 QUALIFICATIONS

A. Applicator's Qualifications:

1. Approved by the manufacturer prior to the bidding period and throughout the installation and able to present a copy of his certification upon request by the Architect or Owner.

2. Applicator must have installed at least five roofs of the same materials and methods specified for this project.

B. Manufacturer's Qualifications:

1. Must have a minimum of 10 years' experience manufacturing SBS modified bitumen roofing membranes.

2. Provide a factory trained technician for final inspection of the roofing system.

3. Provide a warranty upon satisfactory installation of the roofing system.

1.7 REGULATORY REQUIREMENTS

1.8 CODE AND TEST REQUIREMENTS

A. The roof system shall have been tested in compliance with the following codes and test requirements:

1. American Society of Civil Engineers - Reference Document ASCE 7-05, Minimum Design Loads for Buildings and Other Structures.

2. Underwriters Laboratories UL 790 Class A and ASTM E 108 Class A external fire resistance criteria.

3. Underwriters Laboratories (UL) - Roofing Materials and Systems Annual Directory.

4. Factory Mutual Research Corporation windstorm classification 1-540 minimum.

5. Metal flashings shall be in compliance with ANSI-SPRI ES-1 Wind Design Standard for Edge Systems (most recent version prevailing).

6. IBC/IRC - AC75 Evaluation Reports.

7. The roof system assembly shall be installed in compliance with all local building and safety requirements adopted by the local building code jurisdiction.

1.9 DEFINITIONS

A. Roofing Terminology: Refer to the following publications for terms related to roofing work not otherwise defined in this section.

1. ASTM D 1079: Definitions of Terms Relating to Roofing, Waterproofing, and Bituminous Materials.

2. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual

3. Roof Consultants Institute Glossary of Terms

1.10 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference before beginning the work of this section at a time and location to be determined by the Contractor.

1. All parties responsible for work of this section are required to attend including the Owner, Contractor, Architect, and any other trades involved in the roofing work.

2. Review installation procedures and coordination required with related Work.

3. Inspect and make notes of job conditions prior to installation.

1.11 DELIVERY, HANDLING AND STORAGE

A. Deliver all materials and store in their unopened original packaging, bearing the manufacturer's name, related standards and any other specification or reference accepted as standard.

B. Protect and permanently store all materials in a dry, well vented and weatherproof location. Only materials to be used on the same day shall be removed from this location. Keep materials away from open flame or welding sparks.

C. Carefully store on end materials delivered in rolls, with selvage edges up, a minimum of 6-inches above grade. Store metal flashings and counter flashings in such a way as to prevent wrinkling, twisting, scratching and other damage.

1. When stored outdoors, insulation shall be stacked on pallets or dunnage at least 4 inches above ground level and covered with "non-sweating" tarpaulins.

D. Avoid stockpiling materials on roofs without first obtaining acceptance from the Architect/Engineer.

1.12 QUALITY ASSURANCE

A. Submit certification by the manufacturer of the system materials used that these Specifications and the Drawing Details are acceptable to them for the deck and surfacing to which they are to be applied.

1. If details for any manufacturer's systems proposed in the Contract Documents are not acceptable to the manufacturer, submit corresponding details proposed for the particular application, together with the manufacturer's reasons for not accepting

the conditions depicted in the Specifications or Drawings. No alternate details will be considered without evidence of valid objections on the part of the manufacturer to the Contract requirements.

2. No deviation is to be made from this Specification without prior written approval by the manufacturer; submit such approval to the Architect.

B. Inspection: Prior to, during installation and at completion of the installation, an inspection shall be made by a representative of the manufacturer in order to ascertain that the roofing system has been installed according to their published specifications, standards and details.

1. Warranty will be issued upon approval of the installation (See 1.12 of this section).

1.13 JOB CONDITIONS

A. Surfaces on which the roofing membrane system is to be applied shall be clean, smooth, dry, and free of fins, sharp edges, loose and foreign materials, oil and grease.

1. Before beginning work, a representative of the manufacturer shall examine the roof surfaces in order to ensure that the substrate is acceptable.

2. Do not begin installation until all defective conditions have been corrected.

3. All surface voids greater than 1/4 inch wide shall be properly filled with an acceptable fill material.

1.14 WARRANTY

A. Upon completion of the work, furnish to the Owner via the Contractor the manufacturer's written and signed standard system warranty, certifying the performance of his products and the consistency of the properties of such products affecting their performance for periods of ten (10) years from date of acceptance and that installation of the product is in accordance with manufacturer's requirements.

B. The Contractor is to cover damages to the building resulting from failure to prevent penetration of water during construction.

C. The Contractor is to guarantee all work against defects in materials and workmanship for a period of (2) years following final acceptance of the Work.

1.15 SITE PROTECTION

A. During roofing work, exposed surfaces of finished walls and ground shall be protected with tarps in order to prevent damage. Contractor shall assume full responsibility for any damage.

PART 2 PRODUCTS

2.1 GENERAL

A. Base Bid:

1. Soprema Inc.

310 Quadral Dr.

Wadsworth, Ohio 44281

2.2 MEMBRANE

A. Base Ply: SOPRA-FIX F

1. Description: Flashing membrane shall have a non-woven polyester reinforcement and thermo fusible elastomeric asphalt. Both sides shall have a thermo fusible plastic film. This membrane is to be applied by torching only.

2. Components: Reinforcement shall be 3.68 lbs. /sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical Properties: Membrane shall meet requirements according to ASTM 6164 Type 1.

B. Top Ply : SOPRALENE FLAM 180 GR

1. Description: Roofing membrane shall have a non-woven polyester reinforcement and thermo fusible elastomeric asphalt, with fire retardant agents added. The top side shall be self-protected with colored granules. The underside shall be protected by a thermo fusible film. This membrane is to be applied by torching only.

   a. Color to be White.

2. Components: Reinforcement shall be 3.68 lbs. /sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical Properties: Membrane shall meet requirements according to ASTM 6164 Type 1

C. Base Ply Flashing : SOPRALENE FLAM 180

1. Description: Flashing membrane shall have a non-woven polyester reinforcement and thermo fusible elastomeric asphalt. Both sides shall have a thermo fusible plastic film. This membrane is to be applied by torching only.

2. Components: Reinforcement shall be 3.68 lbs. /sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical Properties: Membrane shall meet requirements according to ASTM 6164 Type 1

D. Base Ply Flashing : SOPRALENE FLAM 180 GR 3.5

1. Description: Roofing membrane shall have a non-woven polyester reinforcement and thermo fusible elastomeric asphalt. The top side shall be self-

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protected with colored granules. The underside shall be protected by a thermo fusible film. This membrane is to be applied by torching only.

a. Color to be White.

2. Components: Reinforcement shall be 3.68 lbs. /sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

3. Physical Properties: Membrane shall meet requirements according to ASTM 6164 Type 1

2.3 FASTENERS

A. Decking: Sopra-fix F is to be mechanically attached to the substrate with Tri-fix fasteners and plates.

1. The same brand fastener is to be used throughout the work.

2. Number of fasteners and layout will be as recommended by the manufacturer and as per FM Approval Guide or project criteria for wind uplift.

3. Length of fastener shall be determined by the thickness of the decking and any fill, and will vary with the thickness of the insulation.

2.4 WOOD BLOCKING

A. All nailers and blocking material to be free of wane, shake, decay or checks, and pressure treated with water-borne preservatives for above ground use, AWPB LP-2.

1. Minimum blocking grade is Construction Grade, Southern Pine.

2.5 PRIMER

A. Asphalt Primer: ELASTOCOL 500

1. Apply Primer on all dissimilar materials except insulation.

2. Description: Black bituminous varnish.

3. Composition: Asphalt modified bitumen with thermoplastic polymers and volatile solvents.

2.6 MISCELLANEOUS

A. Expansion Joint Covers: Soprajoint as produced by the membrane manufacturer.

B. Traffic Topping: Sopra-walk, color: White. Provide as Required on Roofing Plans.

C. Water Cut-Off Mastic: Sopracolle or Sopramastic.

D. Sopralene 180 Flam for gusset material.

E. Pitch Box: Construct metal pitch box as per details assuring minimum 2-inch clearance around penetrations with fully welded and hemmed seams.

PART 3 EXECUTION

3.1 SURFACE INSPECTION AND PREPARATION

A. Before commencing work, all surfaces shall be smooth, clean, dry and free of any debris that would adversely affect the installation of the membrane.

1. See 1.11 of this section.

B. Before commencing work, the Owner's representative, together with the roofing contractor shall inspect and approve the deck condition (slopes and nailing supports if applicable) as well as verticals on parapet walls, roof drains, stack vents, vent outlets and others, building joints, etc. If applicable, a non-compliance notice shall be submitted to the contractor so that adjustments can be made. Commencement of work shall imply acceptance of surfaces and conditions.

C. Verify that the work of other trades has been properly completed.

D. Do not install materials in conditions of inclement weather.

3.2 SURFACE PREPARATION

A. (Lightweight Decking): Verify slope and condition of lightweight decking.

1. Replace damaged or defective areas prior to commencement of work under this section.

3.3 INSTALLATION

A. Install roofing membrane on clean and dry surfaces, in accordance with the manufacturer's requirements and recommendations.

B. Perform roofing work on a continuous basis as surface and weather conditions allow.

C. Protect adjoining surfaces against any damage that could result from roofing installation.

D. Install only as much roofing as can be completed in one day. If weather conditions do not permit such completion, exposed areas shall be temporarily weatherproofed to prevent any water or snow infiltration from damaging other materials already installed, in particular, the thermal insulation.

3.4 EQUIPMENT

A. Maintain all equipment and tools in good working order.

3.5 ASPHALT PRIMER APPLICATION

A. Prime all dissimilar surfaces to which asphalt or membrane will come in contact. Apply at the rate of 150 - 200 sq. ft. /gallon. Coat all metal flashings and fascia with primer which will come in contact with membrane.

3.6 BASE PLY INSTALLATION

A. Unroll dry base ply membrane on substrate for alignment. Each strip shall have a minimum four (5) inch side laps and six (6) inch end laps.

1. The base ply Sopra-fix F must be rolled out and allowed to relax a minimum of 30 minutes before torched in place.

2. Begin at low point of roof.

3. Place membrane so edge lap will be centered on drain.

B. The starter roll of the base ply after alignment is to be fastened with approved fasteners.

1. Fastening pattern shall be nine (9) inches O.C. on the laps of 39” wide Rolls.

   Laps shall cover plates a minimum of 1.5 inches, and plates shall be no less than 1/2 inch from the outer edge lap.

C. Each row will be completed before the next row is started.

D. The second row will be torched on the lap only. (The laps are to be torched before they are fastened.)

E. This sequence will continue until all base sheets are applied.

F. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

G. Seal all laps by running a hot trowel along the edge of the seam.

H. Run base ply tight up against any vertical surfaces such as curbs, parapets, and vents. (Fasteners are required at all angle changes at 12” o.c.)

3.7 BASE PLY FLASHING INSTALLATION

A. Prior to application, the vertical surface receiving the base ply flashing shall receive a coat of primer at the rate of 150-200 sq. ft. /gallon. This primer coating must be dry before application of the base sheet flashing.

1. For gusset application refer to 3.19 of this section.

B. Lay base ply flashing in strips three (3) feet wide to the vertical surfaces, extending onto the flat surface of the roof a minimum of four (4) inches. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches with the laps of the base ply.

C. Torch weld base ply flashing directly on its support from bottom to top followed by the torching of the roof tie-in.

D. After installation of base ply flashing, check all lap seams on the flashing by running a heated trowel along the edge of the seams.

1. THOROUGHLY SEAL ALL VOIDS AT ALL CORNERS AND SEAMS.

3.8 TOP PLY INSTALLATION

A. Once the base ply has been completed and does not show any defects, install the top ply.

B. Care must be taken to insure good alignment of the first roll. A 45 degree cut shall be made on the selvage edge of underlying membrane prior to application to insure a good seal between the membranes.

1. If low point is at a drain then the first piece must have granules embedded 4-inches wide along the full length and 6-inches at end laps.

C. Torch weld top ply in accordance with recommendations of Soprema, onto the base ply membrane.

1. During this application, simultaneously melt both surfaces forming an asphalt bead that pushes out in front of the top sheet.

D. Do not to burn the membrane and their respective reinforcements.

E. Top ply shall have side laps of three (3) inches and end laps of six (6) inches. Prior to installation of following ply, embed surface granules on laps by torch heating the membrane surface and pressing the granules into the melted asphalt with a hot trowel.

F. Ensure the two membranes are perfectly welded, without air pockets, wrinkles, fishmouths or tears.

G. After installation of the top ply, check all lap seams on the top ply using the edge of a hot trowel. Correct any defect.

H. During installation, avoid asphalt seepage greater than 1/4 inch at seams.

1. Cover any asphalt seepage with a sprinkling of loose granules, color to match membrane.

3.9 TOP PLY FLASHING INSTALLATION

A. Lay top ply flashing in strips three (3) feet wide.

1. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches from top ply laps in order to avoid excessive thickness.

B. Using a chalk line, lay-out a straight line on the top ply surface, parallel to the roof edge, six (6) inches inside the roof from the base of the cant strip or right angle to be flashed.

C. Using a torch and heated flat trowel, embed the surface granules into the heated and soft bitumen from the chalk line to the edge of the top ply, and to the top of the cant or right angle.

D. Extend top ply flashing down the vertical surface and onto the flat roof at a distance of six (6) inches, to the extent of the area of embedded granules. For ease of application, cut roll into required lengths and use width of roll three (3) feet down length of roof, maintaining specified three (3) inch laps.

1. Torch weld top ply flashing in accordance with recommendations of Soprema, directly on its base ply, proceeding from bottom to top followed by the torching of the roof tie-in.

2. Firmly press flashing into position using a damp sponge.

E. Thoroughly seal all voids in the corners and seams.

F. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

G. During installation, avoid asphalt seepage greater than 1/4 inch at seams.

1. Cover any asphalt seepage with a sprinkling of loose granules, color to match membrane.

3.10 WATER CUT-OFF

A. At the end of the day's work, and when precipitation is eminent, a water cut-off shall be constructed at all open edges. Construct the cut-off with the same membrane and asphalt as that used for the roofing system. Cut-off must be able to withstand extended periods of wet weather. The water cut-off shall be completely removed prior to resuming the installation of the roofing system.

3.11 CLEANING

A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove asphalt markings from finished surfaces.

C. Repair or replace defaced or de figured finishes caused by work of this section.

3.12 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs, structures, vehicles and utilities.

B. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8- inch thick.

C. In addition to the plywood listed above, an underlayment of minimum 1/2-inch recover board is required on new roofing.

1. Special permission must be obtained from the Manufacturer before any traffic will be permitted over new roofing.

3.13 FIELD CONTROL

A. Field inspection will be performed as outlined under 1.10 of this section.

3.14 PITCH BOXES

A. Install metal pitch box as per details assuring minimum 2-inch clearance around penetrations.

1. Provide minimum 6-inch height above finished roofing.

2. Set primed flanges onto base ply after heating metal with a torch assuring box rim is level and true.

B. Seal by torching a reinforcing strip of base ply material that extends beyond the flange a minimum of 6-inches onto the roof.

1. Seal all edges and seams with a heated trowel.

C. Install top ply as specified under 3.8 of this section.

D. Fill box with lightweight concrete filler to a minimum of 1-inche below the top edge. Seal boxes full with Soprema's SBS Elastomeric Bitumen Stick.

1. Provide a constant slope to the outside edge of the box on all sides.

2. Provide a metal storm collar on all boxes.

3.15 ROOF DRAINS

A. Provide a smooth transition from drain bowl to deck surface.

1. Taper insulation back from drain a minimum of 18-inches to provide for positive drainage.

2. Prime all metal surfaces.

3. Using a trowel, set a 6-inch wide layer of mastic around the drain bowl edge as water cut-off.

B. Install base ply membrane with lap centered on bowl and as specified under 3.8 of this section ensuring a tight seal at drain.

1. Install a fully primed, 30-inch square sheet of 4-lb lead flashing set in mastic.

2. Torch into place a reinforcing sheet of base ply material three feet square centered on drain.

3. Extend membranes 1-inch beyond the inside edge of the drain bowl and temporarily secure with clamping ring.

C. Install top ply as specified under 3.8 of this section.

1. Extend membrane 1-inch beyond the inside edge of the drain bowl.

2. Position membrane so as to avoid the occurrence of any seams at drains.

3. Seal off drain by running a hot trowel along the edge and firmly pressing against the rim.

D. Install clamping ring and drain covers supplied with drain.

E. Test all drains for proper flow and water tightness. Correct defects.

3.16 VENT STACK

A. Inspect base ply installation and ensure tight seal around pipe.

B. Construct and install over base ply a sheet metal vent sleeve with welded or soldered seams and as per details.

1. Provide a minimum 5-inch base flange.

2. Prime all metal surfaces.

3. Heat metal flange with torch prior to setting in place and firmly pressing on flange to ensure even contact with roof surface.

C. Torch into place a reinforcing sheet of base ply material three feet square over the vent.

1. Seal all seams and edges with a heated trowel.

D. Install top ply as specified under 3.8 of this section.

1. Cut membrane to fit tight against stack sleeve and seal by running a heated trowel around vent base.

E. Install metal vent cap.

3.17 WALKWAYS

A. At areas outlined on the drawings, install an additional 36-inch wide by 4-foot long sheet of top ply as walkway.

B. Layout sheets dry, adjusting spacing to be uniform. Cut and trim pieces as required to fit conditions, direction changes and closing.

1. No piece shall be less than 24-inches.

2. Provide a 2-inch gap between sheets for drainage.

C. Align the sheets to be straight and true, using a straight edge or snap lines as required.

D. Follow specifications for top ply installation.

3.18 EXPANSION JOINT

A. Ensure all surfaces are soundly secured and fully primed prior to the installation of any membrane or flashing.

B. Install base ply as specified under 3.6 of this section.

1. Stop base ply membrane at juncture of horizontal to vertical surface.

C. Install base ply flashing as detailed and in accordance with 3.7 of this section.

1. Flashing must extend a minimum of 4-inches onto the base ply and continue up the vertical surface onto the top edge of the expansion joint support and be secured using roofing nails at 4 inch on center.

2. Fill the expansion joint with compressible insulation supported by a layer of polyethylene film nailed off along top edge.

D. Provide a continuous joint cover of mineral cushion as detailed.

1. Width of cushion to be three times that of the joint.

E. Install pre-fabricated expansion joint cover by torching flanges onto expansion support and ensuring a minimum of 4-inch surface contact.

F. Install top ply flashing as per 3.9 of this section.

1. Run flashing to top of vertical surface of support and onto roof surface a minimum of 6-inches.

2. Set all granules into membrane using a hot trowel where flashing overlap occurs.

3. Install a slip sheet over joint as separation between joint cover and top ply.

G. Cover the entire expansion joint with a single layer of top ply flashing as detailed and following specifications outlined under 3.9 of this section.

3.19 CORNER FLASHING

A. Inside Corner:

1. Pre-cut all flashing pieces and prime all surfaces prior to installation.

2. Fabricate gusset 4-inch wide by 8-inch long with a 2-inch triangular tip.

a. Install gusset into corner using a torch and firmly pressing with a hot trowel.

b. Set gusset with triangular tip on base ply and wrapping the corner a minimum of 2- inches on each side.

3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at corner.

4. Torch first base flashing sheet into corner over gusset pressing overlap and tie-in firmly into position with a hot trowel.

5. Torch second base flashing sheet into position with edge tight into corner.

a. Cut off base tie-in selvage at 45-degree from vertical.

b. Seal all edges with a hot trowel.

6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at corner.

7. Torch first top flashing sheet into corner over second base ply pressing overlap and tie-in firmly into position with a damp sponge.

a. Set all granules into membrane using a hot trowel where flashing overlap occurs.

8. Torch second top flashing sheet into position with edge tight into corner.

a. Cut off base tie-in selvage at 45-degree from vertical.

b. Press flashing firmly into position with a damp sponge.

c. Seal all edges with hot trowel and sprinkle granules to cover seeping asphalt.

B. Outside Corners:

1. Pre-cut all flashing pieces and prime all surfaces prior to installation.

2. Fabricate gusset 4-inch wide by 8-inch long with a 2-inch triangular tip.

a. Install gusset into corner using a torch and firmly pressing with a hot trowel.

b. Set gusset with triangular tip on base ply and wrapping the corner a minimum 2-inches on each side.

3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at corner.

4. Torch first base flashing sheet into corner over gusset pressing overlap and tie-in firmly into position with a hot trowel.

5. Torch second base flashing sheet into position with returns wrapped around corners.

a. Cut off base tie-in selvage at 45-degree from vertical.

b. Seal all edges with a hot trowel.

6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at corner.

7. Torch first top flashing sheet into corner over second base ply pressing overlap and tie-in firmly into position with a damp sponge.

a. Set all granules into membrane using a hot trowel where flashing overlap occurs.

8. Torch second top flashing sheet into position with edge tight into corner.

a. Cut off base tie-in selvage at 45-degree from vertical.

b. Press flashing firmly into position with a damp sponge.

c. Seal all edges with hot trowel and sprinkle granules to cover seeping asphalt.

3.20 CURBS

A. Inspect and verify that all curbs are properly secured to deck, are level, a minimum 8-inches above finished roof, primed and ready to receive flashings.

B. Base ply membrane is to run horizontally tight up against the vertical curb or cant as required.

1. When base ply membrane is to act as temporary seal for an extended length of time, carry membrane up vertical surface a minimum of 1-inch.

C. Gusset to be fabricated 4-inch wide by 8-inch long with a 2-inch triangular tip.

1. Install gusset onto corner using a torch and firmly pressing with a hot trowel.

2. Set gusset with triangular tip on base ply and wrapping the corner a minimum 2-inches on each side.

D. Install base ply flashing according to 3.7 of this section.

1. Pre-cut flashing to the total sum of curb height, thickness plus 1-inch for inside curb securement and 4-inch tie-in along base with width to match that of curb plus 3-inch overlap on each end.

2. Secure along inside of curb with roofing nails.

3. Cut back corner base selvage at 45-degree angle from vertical.

E. Install top ply membrane and flashing as specified under 3.8 and 3.9 of this section.

1. Pre-cut flashing to the total sum of curb height plus 6-inches for base tie-in with width to match that of curb plus 3-inch overlap at each end.

2. Set granules with heated trowel on all surfaces to receive flashing.

3. Cut flashing flush with the top of curb and seal edges with heated trowel.

4. Cut back corner base selvage at 45-degree angle from vertical.

5. Firmly press flashing into position using a damp sponge.

F. Provide metal counter flashing.

3.21 ROOF EDGE

A. Install base ply membrane as specified under 3.6 of this section. Carry membrane over roof edge a minimum of 3-inches and temporarily fasten using galvanized roofing nails.

B. Install a continuous metal cleat (material) and edge as detailed.

1. Prime all dissimilar surfaces prior to membrane or flashing installation.

2. Flange on edge to be 4-inch minimum.

3. Nail flange to decking or wood blocking at 4-inch center, staggered, 1-inch from outside edge.

C. Cover edge with an eight (8) inch reinforcing strip of base membrane torched into place. Membrane is to carry beyond the metal flange onto base ply a minimum of 4-inches.

1. Hold the reinforcing strip back from outside edge of metal by 3/4-inch.

2. Seal all edges with a hot trowel.

D. Install top ply of membrane according to 3.8 of this section with the edge tight against the metal and sealed with a hot trowel.

3.22 COPING / PARAPETS

A. Verify all surfaces are properly secured and fully primed, ready to receive flashings.

B. Base ply membrane is to run horizontally tight up to the vertical or cant as required.

C. Install base ply flashing according to 3.9 of this section. Carry flashing up the vertical surface, over the top and down the outside face of the parapet a minimum of 3-inches. Fasten along outside edge at 4-inch centers using roofing nails.

1. Install a continuous metal cleat (material) and edge as detailed.

   a. Prime all dissimilar surfaces prior to membrane or flashing installation.

   b. Flange on edge to be 4-inch minimum.

   c. Nail flange to wood blocking at 4-inch center - staggered.

2. Cover edge with a reinforcing strip of base membrane torched into place. Membrane is to carry beyond the metal flange onto base ply a minimum of 4-inches.

   a. Hold the reinforcing strip back from outside edge of metal by 3/4-inch.

   b. Seal all edges with a hot trowel.

D. Torch weld top ply membrane and flashing as detailed and specified under 3.8 and 3.9 of this section.

END OF SECTION 07 52 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Manufactured reglets.
2. Formed roof drainage system.
3. Formed low-slope roof flashing and trim.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions, and details for fastening, joining, supporting, and anchoring sheet metal flashing and trim.

C. Samples: For each type of sheet metal flashing and trim.

1.3 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including built-in gutter approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments underlayment and accessories.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Pre-installation Conference: Conduct conference at Project site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with the requirements of this Section, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in roofing submittals.

2.2 SHEET METALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality, mill phosphatized for field painting.

B. Pre-painted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2. Exposed Finishes: Apply the following coil coating:

a. Factory Prime Coating: Factory-applied, baked on epoxy primer coat.

3. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lb./100 sq. ft. (0.16 kg/sq. m).

C. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.

3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.4 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.

1. Manufacturers:

a. Fry Reglet Corporation.

b. Hickman, W. P. Company.

2. Material: Galvanized steel, 0.0217 inch (0.55 mm) thick.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch long, but not exceeding 10-foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.

1. Fabricate copings from the following material:

a. Pre-painted, Metallic-Coated Steel: 0.0396 inch (1.0 mm).

B. Base Flashing: Fabricate from the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick

2. Pre-painted, Metallic-Coated Steel: 0.0217 inch (0.55 mm) thick.

C. L-Shaped Flashing:

1. Coordinate L-Shaped Flashing profile and base flashing for existing concrete parapet with parapet coping at Autobanco facia parapet to form a continuous, seamless edge.

2. Fabricate from the following material:

a. Pre-painted, Metallic-Coated Steel: 0.0396 inch (1.0 mm).

D. Counterflashing: Fabricate from the following material:

1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.

2. Pre-painted, Metallic-Coated Steel: 0.0217 inch (0.55 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.

2. Pre-painted, Metallic-Coated Steel: 0.0276 inch (0.7 mm) thick.

F. Roof-Drain Flashing: Fabricate from the following material:

1. Zinc-Tin Alloy-Coated Stainless Steel: 0.015 inch (0.4 mm) > thick.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

C. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with [elastomeric] [butyl] sealant concealed within joints.

E. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal, and in thickness not less than that of metal being secured.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with [elastomeric] [butyl] sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Galvanized or Pre-painted, Metallic-Coated Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pre-tinned surface would show in finished Work.

1. Do not solder pre-painted metallic-coated steel or aluminum sheet.

3.2 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.

1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16-inch (400-mm) centers.

2. Anchor interior leg of coping with screw fasteners and washers at 18-inch (450-mm) centers.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Secure in a waterproof manner. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

2. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

END OF SECTION 07 62 00

SECTION 07 84 13 - THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated construction assemblies, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling, or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
    a. Penetrations located outside wall cavities.
    b. Penetrations located outside fire-resistance-rated shaft enclosures.
3. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and finishes.

A. Include printed statement of VOC content from a third-party certification organization per Section 01 81 16 Volatile Organic Compounds (VOC) Content Requirements.

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Whenever feasible, obtain firestop materials and systems from a single source and from a single manufacturer.

B. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

C. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

E. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.

2. Hilti, Inc.

3. 3M; Fire Protection Products Division.

4. Tremco; Sealant/Weatherproofing Division.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content:

1. When calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24).

2. Per 01 81 16 VOC Limits for Adhesives, Sealants, Paints, and Coatings.

3. Provide third-party certifications to demonstrate compliance with VOC Content requirements per Section 01 81 16.

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PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Identification: Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.2 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage an independent inspecting agency to inspect through-penetration firestops. An independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-1235, W-L-1152, W-L-1153 or equivalent.

C. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-2172, W-L-2166 or equivalent.

D. Firestop Systems for Electrical Cables:

1. UL-Classified Systems: C-AJ-3136, W-L-3116, or equivalent.

E. Firestop Systems for Cable Trays:

1. UL-Classified Systems: C-AJ-4038, W-L-3116 or equivalent.

F. Firestop Systems for Insulated Pipes:

1. UL-Classified Systems: C-AJ—5116, W-L-5099 or equivalent.

G. Firestop Systems for Miscellaneous Mechanical Penetrations:

1. UL-Classified Systems: W-J-7008, W-L-7027 or equivalent.

END OF SECTION 07 84 13

SECTION 07 84 46 - FIRE-RESISTIVE JOINT 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. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior wall/floor intersections.
3. Joints in smoke barriers.

B. Related Sections:

1. Section 01 81 16 “Division 01 Section Volatile Organic Compound (VOC) Content Requirements.
2. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 ACTION SUBMITTALS

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

B. For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content from a third-party certification organization per Section 01 81 16 Volatile Organic Compounds (VOC) Content Requirements.

C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
    a. Fire-resistive joint system products bear classification marking of qualified testing agency.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage.

B. Joints in or between Fire-Resistance-Rated Construction: Ratings determined per ASTM E 1966 or UL 2079:

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Grace Construction Products.
    b. Hilti, Inc.
    c. 3M Fire Protection Products.
    d. Tremco, Inc.; Tremco Fire Protection Systems Group.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01- inch wg or ASTM E 2307.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

2. Manufacturers: Subject to compliance with requirements, provide the following, or equal:
    a. Grace Construction Products.
    b. Hilti, Inc.
    c. 3M Fire Protection Products.
    d. Tremco, Inc.; Tremco Fire Protection Systems Group.

D. Joints in Smoke Barriers: Ratings determined per UL 2079.
1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30-inch wg at both ambient and elevated temperatures.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
    a. Grace Construction Products.
    b. Hilti, Inc.
    c. 3M Fire Protection Products.
    d. Tremco, Inc.; Tremco Fire Protection Systems Group.

E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content:
1. When calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24).
2. Per 01 81 16 Volatile Organic Compounds (VOC) Content Requirements.
3. Provide third-party certifications to demonstrate compliance with VOC Content requirements per Section 01 81 16.

G. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by a fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing the fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

D. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply fill materials so they contact and adhere to substrates formed by joints.

3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.

3. Designation of applicable testing agency.

4. Date of installation.

5. Manufacturer's name.

6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire resistive joint systems complying with specified requirements.

END OF SECTION 07 84 46

SECTION 07 92 00 – JOINT SEALANTS

PART 1 GENERAL

1.1 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.
5. Substrates for which use of primer is required.
6. Substrates for which laboratory adhesion and/or compatibility testing is required.
7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
8. Sample product warranty.
9. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 016116.

1.2 QUALITY ASSURANCE

A. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Deliver to manufacturer sufficient samples for testing.
2. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
3. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

PART 2 PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    a. Wall expansion and control joints.
    b. Joints between door, window, and other frames and adjacent construction.
    c. Joints between different exposed materials.
    d. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    a. Joints between door, window, and other frames and adjacent construction.
    b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
        1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
    c. Other joints indicated below.
3. Do not seal the following types of joints.
    a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    c. Joints where installation of sealant is specified in another section.
    d. Joints between suspended panel ceilings/grid and walls.

B. Type JS-1 - Exterior Joints: Use non-sag neutral and basic curing sealant, unless otherwise indicated.

C. Type JS-2 - Interior Joints: Use non-sag neutral and basic curing silicone sealant, unless otherwise indicated.

D. Type JS-3 - Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.2 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 016116.

B. Colors: As selected by Architect.

2.3 NONSAG JOINT SEALANTS

A. Type JS-1 and JS-2 - Silicone Sealant: ASTM C920, Grade NS, Use NT; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 50 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Cure Type: Single-component neutral and basic curing.

B. Type JS-3 - Mildew-Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Use NT; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: White.
3. Cure Type: Acid curing.

2.4 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi- Cellular Polyethylene.
3. Open Cell: 40 to 50 percent larger in diameter than joint width.
4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Non-sag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 07 92 00

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Environmental Product Declaration Documentation including EPD's, product comparison documentation, third-party certification documentation and life cycle analysis documentation.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

PART 2 PRODUCTS

2.1 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: Manufacturers 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 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 SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) 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.

2.2 HOLLOW METAL DOORS

A. Door Finish: Factory primed, and field finished.

B. Exterior Doors:

1. Thermally insulated. Provide R 11 Urethane insulation.
2. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
3. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

C. Interior Doors, Non-Fire-Rated:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed 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 (44.5 mm), nominal.

D. Interior Door, Fire-Rated:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.

e. Zinc Coating: A60/ZF180 galvannealed 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. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.

4. Provide units listed and labeled by UL (DIR) or ITS (DIR).

a. Attach fire rating label to each fire rated unit.

5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.

6. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.3 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. 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: 14 gage, 0.067 inch (1.7 mm), minimum.

3. Frame Finish: Factory primed, and field finished.

a. Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10-inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.

b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.

C. Interior Door Frames, Non-Fire Rated: Slip-on type on gypsum board walls, and knock-down type on masonry walls.

1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.

2. Frame Finish: Factory primed, and field finished.

D. Door Frames, Fire-Rated: Slip-on type on gypsum board walls, and knock-down type on masonry walls.

1. Fire Rating: Same as door, labeled.

2. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.

3. Frame Finish: Factory primed, and field finished.

E. Sound-Rated Door Frames: Slip-on type on gypsum board walls, and knock-down type on masonry walls:

1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
2. Frame Finish: Factory primed, and field finished.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.

I. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.4 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch (0.4 mm) dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.5 ACCESSORIES

A. Door Vision Panel Window Frames: Door window frames with glazing securely fastened within door opening.

1. Size: As indicated in the drawings.
2. Frame Material: 18 gage, 0.0478 inch (1.21 mm), galvanized steel.
3. Metal Finish: Factory primed for field finish.
4. Glazing: 1/4 inch (6.4 mm) thick, tempered glass, in compliance with requirements of authorities having jurisdiction.

B. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.

1. UL listed products in compliance with requirements of authorities having jurisdiction.
2. Provide double integral astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
3. Material: Manufacturers standard.
4. Metal Finish: To match door.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

E. 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.

F. Temporary Frame Spreaders: Provide factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 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.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. Product Data for adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

E. Samples for Initial Selection: For factory-finished doors.

F. Warranty: Sample of special warranty.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
2. Provide WI-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
3. Provide WI-Certified Compliance Certificate for installation.

D. Forest Certification: Provide doors made with not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system or temporary ventilation is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.

   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Algoma Hardwoods, Inc.

2. Lambton Doors.

3. Marshfield Door Systems, Inc.

4. Mohawk Flush Doors, Inc.; a Masonite company.

5. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. WDMA I.S.1-A Performance Grade: Heavy Duty.

C. Agrifiber-Core Doors:

1. Agrifiber Core: ANSI A208.1, Grade LD-1 or Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

D. Fire-Protection-Rated Doors: Not Used

2.3 PLASTIC LAMINATE-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors

1. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HPDL
2. Colors, Patterns, and Finishes: As indicated in the Architectural drawings Door Schedule Notes.
3. Exposed Vertical Edges: Plastic laminate that matches faces, applied before faces.
4. Core: Agrifiber based particleboard or Glued wood stave.
5. Construction: Three plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces are applied. Faces are bonded to core using a hot press.
6. Adhesives: Type I per WDMA TM-6.
7. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 VISION LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.5 LOUVERS

A. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: Species compatible with door faces.
2. Louver Type: Flat slat.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

D. Finish doors at factory where indicated in schedules or on Drawings as factory finished.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    a. Comply with NFPA 80 for fire-rated doors.
2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Repaired or refinished doors may be accepted if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 51 13 - ALUMINUM WINDOW SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Joint Sealers – Section 07 92 00

B. Glass and glazing – Section 08 80 00

1.2 SUMMARY

A. Section includes:

1. Fixed Heavy Commercial Grade aluminum fixed windows.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA).

B. American Society for Testing Materials (ASTM)

C. American National Standards Institute (ANSI)

1.4 TEST AND PERFORMANCE REQUIREMENTS

A. Provide aluminum window system designed to accommodate expansion and contraction due to normal thermal movement and wind loading per manufacturer's window test reports. Establish basic dimension of units, sight lines, and profiles of members according to the performance requirements.

B. Products of other manufacturers equal to or exceeding those specified herein will be considered upon written authorization by the Architect. Information, including window sample (size and configuration per Architect's requirements), must be submitted for consideration a minimum of 10 days before project bid date.

C. Test Criteria: Testing shall be performed by an AAMA qualified independent testing agency and be based on the following criteria:

D. Current test reports must be submitted and be AAMA certified to be accepted.

E. Performance Requirements: Test reports must show compliance with AAMA/WDMA/CSA 101/I.S.2/A440-08 for CW-PG100.

1.5 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

1. Product Data: Submit for windows.

a. Include information for factory finishes, glass, glazing components, accessories, and other required components.

b. Submit certified test reports from AAMA accredited laboratories verifying all performance requirements specified herein.

2. Shop Drawings: Indicate elevations, detailed design, dimensions, member profiles, joint locations, arrangement of units, and member connections.

a. Anchorage system.

b. Interfacing with building construction.

c. Full-size details of special and typical shapes.

d. Indicate glazing details and sealant requirements.

e. Show finishes indicating compliance with the specification.

f. Indicate recorded field measurements on final drawings as available.

3. Samples: Indicate quality of finish on alloys used 12 inches long for extrusions and 6 inches square for sheet materials.

a. Where normal texture or color variations are expected, include additional samples illustrating range of variation.

4. Samples for Verification: Submit samples of anchors, fasteners, hardware, assembled corner sections, and other materials and components if requested by the architect.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified in writing that installer has experience on at least five projects of similar nature in past five years. The installer shall warrant the satisfactory performance of the window installation which includes, but is not limited to, installation accessories, (glazing, perimeter sealing,) and anchorage as called for by the specifications and approved shop drawings.

B. Single Source Responsibility: Provide window units manufactured by one manufacturer.

1.7 DELIVERY STORAGE AND HANDLING

A. Glass and glazing for window units are required as work of this section for single source responsibility. Field glaze units.

B. Protect glass and glazing to prevent chipping, cracking, and other similar damages.

C. Store windows in upright position, off ground.

D. Protect finished surfaces to prevent damage.

E. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.

F. Do not leave coating residue on surfaces.

G. Protect the window units form lime, mortar, runoff from concrete and copper, careless handling of tools, weld splatter, acids, roofing tar, solvents, abrasive cleaners, and other items that could damage the window units.

1.8 WARRANTY

A. Warranty: The window manufacturer shall provide a written warranty that window units are free from defective materials or workmanship within a specified period. Failures include the following:

1. Material defect in manufacture.

B. Warranty Period for Glazing: 5 years after delivery of product.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Glasstra Aluminum Inc.
2. Green Windows
3. AirMaster

2.2 WINDOWS, INTERIOR STOREFRONTS, AND CURTAIN WALLS

A. Project design is based on the following products: contractor may submit other manufacturer products subject to the compliance of the specified product.

1. Exterior Aluminum Windows (A, per Window Schedule): Glasstra Aluminum Inc. FG-5000 Series Impact-Resistant Framing System, 2 ½ inches sight line, main section 5 inches deep.
   a. Glazing: GT-1 Laminated Glass Units, as specified in Section 08 80 00 Glass and Glazing.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 MATERIALS

A. Aluminum extrusions shall comply with ASTM B 221 and tolerances shall be in accordance with the Aluminum Association's "Drafting Standards for Aluminum Extruded and Tubular Products". Extrusions shall not be less than a nominal 0.062 inch thick at any location for main frame with the exception of glazing stop which shall be no less than a nominal 0.050 inch. Sheet shall comply with ASTM B 209, alloy and temper recommended by manufacturer appropriate for specified finish.

B. Fasteners: Provide stainless steel fasteners, corrosion resistant and compatible with aluminum.

1. Reinforcement: When fasteners screw into aluminum less than a nominal 0.062 inch thick, utilize nuts or washers of design having means to reinforce interior aluminum surfaces and prevent disengagement.

2. Exposed Fasteners: Provide concealed fasteners wherever possible.

C. Shims: Non-staining and non-ferrous type.

D. Glazing tape: Blend of polyisobutylene and butylpolymer complying with AAMA 807.3-92

E. Sealants: The color of the sealant exposed with the window in the closed position shall be chosen from the manufacturer's standards. If unspecified, the sealant color shall be compatible with the window framing materials.

1. Non-working joints: Sealant shall comply with AAMA 800.

2. Window Components: Sealant shall be suitable for application specified and approved by the window manufacturer.

3. Perimeter: Sealant shall comply with AAMA 800 and Section 07 92 00 Joint Sealers.

F. Compression-Type Gaskets: Provide compressible TPE stripping for glazing and weatherstripping complying with ASTM D 1921, ASTM D 792, ASTM D 2240, ASTM D 412, ASTM D 590, and ASTM D 3835 molded TPE gaskets.

2.4 ACCESSORIES

A. Mullions: Provide extruded aluminum mullions with a minimum nominal wall thickness of .062 inch and cover plates, where required, to complete window to window connections.

B. Subsills: Provide subsills with a minimum nominal wall thickness of 0.062 inch. Provide subsills with means to weep water to the exterior. Finish subsills to match windows.

C. Panning: Provide extruded aluminum panning of the type and configuration required by the architect with a minimum nominal wall thickness of 0.062 inch. Provide one row of vinyl gasket placed into extruded grooves in each panning member to ensure no window unit to panning metal contact. Provide stainless steel clips for the head and jamb panning members. Clips shall be attached with stainless steel fasteners. Space stainless steel clips appropriately to allow the window units to secure themselves tightly to the panning. Window units shall lip over the panning sill member allowing water to weep to the exterior. Finish panning to match window units.

D. Trims: Provide extruded aluminum trim of the type and configuration required by the architect with a minimum nominal wall thickness of .050 inch. Provide extruded aluminum trim clips, with a minimum nominal wall thickness of .050 inch, to allow attachment of the trim to the window units and/or openings. Finish trim to match window units.

2.5 FABRICATION

A. Fabricate components in accordance with manufacturer's tested assemblies. Remove burrs and ease edges. Shop fabricate to greatest extent practicable to minimize field assembly. Disassemble only to the extent necessary for shipping and handling limitations.

2.6 FINISHES

A. Clear Anodized, Class I: Etched, medium matte, clear anodic coating, 0.7 mil thickness. Meeting AAMA 611-98 and AA-M12C22A41.

PART 3 EXECUTION

3.1 INSPECTION

A. Remove and properly dispose of existing windows in accordance with Section 02 41 00 Selective Demolition. Verify that openings are dimensionally within allowable tolerances, plumb, level, and clean. Provide solid anchoring surfaces that are in accordance with approved shop drawings.

B. Verify that the opening into which the windows will be installed is the correct size to permit installation of the new windows according to the manufacturer's installation instructions.

C. Do not install windows until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install windows with skilled tradesperson in exact accordance with approved shop drawings.

B. Aluminum that is not organically coated shall be insulated from direct contact with steel, masonry concrete or noncompatible materials by bituminous paint, zinc chromate primer, or other suitable insulating material.

C. Install vapor retardant tape between window perimeter and adjoining collateral materials and existing wall barriers to insure continuity.

D. Plumb and align window face in a single plane for each wall plane. Erect square and true. Anchor to maintain position when subjected to normal thermal and building movement (seismic forces), and specified wind loads.

E. Install glass and glazing in accordance with approved shop drawings to provide satisfactory, leak-free installation.

F. Perimeter Sealing: Seal joints at the perimeters in accordance with approved shop drawings to provide watertight installation.

G. Joints and surfaces to receive sealants shall be clean, free from loose material, dust, and debris.

H. Clean the joints and surfaces before sealing or priming. Then prime the joints in accordance with the sealant manufacturer's instructions.

I. Provide joint backing in all joints where a suitable backer to receive sealant is otherwise not available. Joint depth shall be equal to ½ of the width.

J. Caulk joint width shall not be less than ¼ inch nor more than ½ inch unless otherwise recommended by the sealant manufacturer. Wipe off the excess material and leave the exposed surfaces and joints clean and smooth.

3.3 ADJUSTING

A. After installation, windows and glazing shall be inspected and adjusted to provide smooth operation and a weathertight window system.

3.4 CLEANING

A. After installation, leave windows and frames clean and free of temporary labels and dirt. Protect finished installation against damage.

B. Final cleaning of the anodized finish shall be in accordance with AAMA 609.1.

C. Final cleaning of the painted finish shall be in accordance with AAMA 610.1.

END OF SECTION 08 51 13

08 71 00 – BUILDER'S HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Builder's hardware for interior and exterior doors.

1.2 RELATED SECTIONS

A. Section 08 11 13: "Hollow Metal Doors and Frames"

B. Section 08 14 16: "Flush Wood Doors".

C. Section 09 90 00: "Painting and Coatings" for field finishing doors.

D. Section 28 31 00: "Fire Detection and Alarm" for connections to building fire alarm system.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI 156.1-1988 - Butts and hinges.
2. ANSI 156.2-1983 - Bored & preassembled locks.
3. ANSI 156.3-1984 - Exit devices.
4. ANSI 156.4-1986 - Door control (Closer).
5. ANSI 156.5-1984 - Auxiliary locks.
6. ANSI 156.13-1987 - Mortise locks & latches.
7. ANSI 156.16-1989 - Auxiliary hardware.
8. ANSI 156.18-1987 - Materials & finishes.
9. ANSI 117. 1-1986 - Providing accessibility and usability for physical handicapped people.

B. National Fire Protection Association (NFPA):

1. NFPA 80 -Fire Doors and Windows.
2. NFPA 101-Life Safety Code 2018

C. Puerto Rico Building Code

1. "Reglamento de Edificación-P.R." 2018 / International Building Code (IBC) 2018.

1.4 QUALITY ASSURANCE

A. Hardware shall conform to the following standards:

1. All butts shall comply with ANSI A2112 and A2133.
   a. Butts on outswing exterior doors shall have non-removable pins (NRP).

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b. Provide Ball Bearing Hinges at Self Closing Doors

2. Locksets and latches shall meet the following minimum ANSI standards.

   a. Heavy duty cylindrical locks -ANSI Series 4000, Grade 1.

   b. Mortise Locks-ANSI Series 1000, Grade 1 test requirements.

   c. Use UL approved locks on labeled fire doors.

3. Door closers shall comply with ANSI Series C02011, Grade 1 with cast iron case and adjustable back check. Closers for reverse bevel doors and all doors opening towards a hallway shall comply with ANSI Series CO2021, Grade 1 and be sized according to the manufacturer's recommendation.

4. Exit devices shall be of the modern push bar type, ANSI Grade 1. All pair openings with a combination mortise and vertical rod device shall be equipped with an open back strike. Pair openings with a combination rim. Vertical rod device and door closers on each door shall be equipped with a type-21 door coordinator.

1.5 SUBMITTALS

A. The hardware supplier shall submit electronic format copies of a complete hardware schedule for approval. See Division 1 of the Specification.

1. Preface sheet listing category only and manufacturers name of items being furnished, as follows:

Category	Specified	Scheduled
Hinges	Mfg."A"	Mfg."B"
Locksets	Mfg."C"	Mfg."D"
Kickplates	Open	Mfg."X"

2. For hardware locations, see Article 3.3 - Locations.

3. Open description: Single or pair, number, room locations, hand, active leaf, degree of opening, size, material, frame material, and fire rating.

4. Hardware description: Quantity, category, product number, fasteners, and finish.

5. Headings that refer to the specified Hardware Set Numbers.

6. Scheduling sequence shown in Hardware Sets.

7. Product data of each hardware item and shop drawings, where required, for special conditions and specialty hardware.

8. Vertical scheduling format only. Horizontal schedules are not acceptable.

9. Typed copy.

10. Double spacing.

11. Eight and one-half by eleven-inch (8 1/2"x 11") sheets.

12. U.S. Standards finish symbols.

B. Samples: Submit sample of each type of builder's hardware item proposed for project. If approved, samples may be used in project.

1.6 DELIVERY, STORAGE AND HANDLING

A. Package and deliver hardware items separately and mark each to correspond with heading numbers on hardware schedule.

B. Include necessary instructions, templates, drawings, and fasteners for proper installation.

1.7 JOB CONDITIONS

A. Furnish templates to the hollow metal and frame manufacturer as required for installing the hardware to avoid any delay in fabrication.

B. See Article 3.3 - Locations and coordinate with templates.

C. Sub-contract the furnishing of builder's hardware to a recognized local builder's hardware representative for the lockset being furnished. The local hardware supplier must have been furnishing builders hardware for a period of not less than 5 years and must have in his employment an experienced hardware consultant who is available at all reasonable times during the course of the work for project hardware consultation to the owner or architect. Hardware supplier must furnish all hardware required to comply with applicable government regulations from American Disability Act, and National Fire Protection Association.

1.8 REGULATORY REQUIREMENTS

A. Contractor must provide hardware to conform to:

1. All applicable codes for fire rated doors and frames.

2. All applicable sections of Chapter 5 of N.F.P.A. 101.

3. ANSI A117.1 for hardware locations and requirements to meet all handicapped codes of the American with Disabilities Act.

4. Quantities shown on schedule are for reference only. Final count is the contractor's responsibility.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General:

1. Products listed are consistent with the standard hardware sets installed at Banco Popular Branch Office facilities and are meant to be a guideline for this project.

2. Substitute products will only be considered in specific conditions that require hardware components or combinations not previously used in in Banco Popular Branch facilities.

B. Locks and latches:

1. Hager / Sargent.

C. Door Closers:

1. Cal Royal / Sargent

D. Manufacturers of other items:

1. Butts: Hager
2. Mortise Cylinder: Sargent
3. Turn knob Cylinder: Ilico
4. Dead Bolts: Arrow
5. Exit Devices: Sargent
6. Floor Closers & Pivots: Sargent
7. Overhead Door Holders: Sargent
8. Door Pulls: Rockwood, Trimco
9. Flush Bolts: Trimco
10. Kick Plates: Trimco
11. Bolts: Rockwood, Trimco
12. Stops: Trimco
13. Door Silencers: Trimco
14. Thresholds: Pemco
15. Coat Hooks: Trimco
16. Automatic Door Bottoms: Pemco
17. Acoustic Corner Pads: Pemco
18. Rain Drips: Pemco
19. Head Seals: Pemco
20. Jamb Seals: Pemco
21. Electromagnetic Locks and Keypads: Assa Abloy HES Securitron
22. Transformers: Trine

23. Padlocks -American- Corbin Russwin

2.2 LABEL REQUIREMENTS

A. Furnish Underwriters Laboratories, Inc. approved hardware items, meeting requirements of NFPA 80, at doors scheduled to be label doors.

2.3 FINISHES

A. Unless otherwise specified on hardware schedule all finishes will be as follows:

1. Butts and Pivots: 630
2. Locksets, Deadlocks, Padlocks and Latches: 626 (Except MS1850-628).
3. Exit Devices: 626.
4. Closers: Sprayed aluminum to match; 626 on Floor Type.
5. Pulls & Plates: 630.
6. Stops/Holders: 626.
7. Flush Bolts: 626.

2.4 KEYING

A. Key and master key in accordance with owner's requirements and approved keying schedule. Furnish 3 change keys for each lock, and 3 ea. Master keys, and 10 construction keys.

B. Where specified all cylinders shall be of the high security Type with interlocking pins and skew out key biting.

C. Furnish a complete key control system that provides tags for each individual change key and a key cabinet that will hold 150% of the key capacity of the building.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine door frames and related items for conditions that would prevent proper application of builder’s hardware.

B. Do not proceed until defects are corrected, with approval obtained from owner or his designated representative.

3.2 INSTALLATION

A. Install hardware according to manufacturer's printed instructions and to template dimensions. See Article 1.6.

B. All hardware shall be installed in a neat workmanlike manner by experienced workmen and left in perfect working condition. Any hardware lost or damaged shall be replaced at no additional cost to the owner.

3.3 LOCATIONS

A. Dimensions are from finish floor to center line of items.

B. Include this list in Hardware Schedule:

Category	Dimension
1. Hinges	Door manufacturer standards
2. Flush Bolt Levers	72" and 12"
3. Knobs	Door manufacturer standard
4. Exit Device Crossbars	Manufacturer's Template
5. Push Plates	52"
6. Pull Plates	42"
7. Wall Stops	At Head

3.4 FINAL ADJUSTMENT

A. Provide the services of a representative to inspect material furnished and its installation and adjustment, to make final hardware adjustment, and to instruct the Owner's personnel in adjustment, care, and maintenance of the hardware.

3.5 HARDWARE SETS

A. Refer to this project's Architectural drawings for Door and Hardware schedule.

B. Keying : all locks regular system, 3 master key & 2 ea. day keys per lock unless noted otherwise on this schedule or corrected by owner / architect

C. Aluminum entrance doors: all hardware provided by door supplier.

3.6 REFERENCES:

HAG HAGER
SAR SARGENT
TRI TRIM CO
PEM PEMKO
ARR ARROW
CRP CAL ROYAL
KDM KABA DORMA
ILC ILCO
TRN TRINE

3.7 NOTES:

A. Provide xc proprietary cylinders and keys protected from unauthorized manufacture and distribution by manufacturer's united states patents.

B. All public areas locks master key & construction key

C. All apartment locks construction key only.

D. 3 keys per lock

E. 2 masters keys

F. 10 construction keys

G. All locks must be BHMA certified.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLASS AND GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Monolithic two-ply laminated glass for light and solar control, exterior and interior tempered glass units, fire rated glass, and mirrors.

B. Related Sections

1. Drawings, General and Supplementary Conditions of the Contract, Division 1 and the following Specification Sections, apply to this Section.
2. Section 07 92 00 - Joint Sealers
3. Section 08 11 13 – Hollow Metal Doors and Frames
4. Section 08 14 16 – Flush Wood Doors
5. Section 08 41 10 –Aluminum Window Systems
6. Section 09 29 00 Gypsum Board Assemblies

1.02 REFERENCES

A. ANSI:

1. ANSI Z97.1 - American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASTM:

1. ASTM C162 - Standard Terminology of Glass and Glass Products.
2. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass -- Kind HS, Kind FT Coated and Uncoated Glass.
3. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
4. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
5. ASTM E1300 - Standard Practice for Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load.

C. CPSC

1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

D. GANA:

1. GANA Glazing Manual; Glass Association of North America.
2. GANA Sealant Manual; Glass Association of North America.
3. GANA Laminated Glass Design Guide; Glass Association of North America.

1.03 DEFINITIONS

A. Two-ply laminated glass: Two sheets of monolithic glass bonded together with a plastic interlayer by heat and pressure.

B. Laminated Glass Unit Surfaces & Coating Orientation:

1. Surface 2 - Exterior surface of outer pane (surface facing outdoors of outboard lite).

C. Performance Characteristics

1. Center-of-Glass - Performance values that take only the center portion of a glass makeup into account and not the framing members. Customarily found in Sweets catalogs and Oldcastle BuildingEnvelope® GlasSelect® and identified in Paragraph 2.02 of Section 08 80 00.
2. Glass thermal and optical performance properties shall be based on data and calculations from the current LBNL WINDOW 7.7.10 computer program.
3. Fenestration Performance - Performance values that take into account the total fenestration (center-of-glass and framing members). Normally identified with building energy codes such as ASHRAE-IESNA 90.1 2016 and the IECC 2018. These values can also be tested and certified by the National Fenestration Rating Council (NFRC).

1.04 SYSTEM DESCRIPTION

A. Design Requirements

1. Provide glazing systems capable of withstanding normal thermal movements, wind loads and impact loads, without failure, including loss due to defective manufacture, fabrication and installation; deterioration of glazing materials; and other defects in construction.
2. Provide glass products in the thicknesses and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on project loads and in-service conditions per ASTM E1300.
    a. Minimum thickness of annealed or heat-treated glass products is selected, so the worst-case probability of failure does not exceed the following:
        1) 8 breaks per 1000 for glass installed vertically or not over 15 degrees from the vertical plane and under wind action.
        2) 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind.

1.05 SUBMITTALS

A. Submit 12-inch (305mm) square samples of each type of glass indicated (except clear monolithic glass products), and 12-inch (305mm) long samples of each color required (except black) for each type of sealant or gasket exposed to view.

B. Submit manufacturer's product data sheet and glazing instructions.

C. Glazing contractor shall obtain compatibility and adhesion test reports from sealant manufacturer, indicating that glazing materials were tested for compatibility and adhesion with glazing sealant, as well as other glazing materials including insulating units.

D. Glazing Contractor shall provide test reports showing that the glass meets the requirements of any security test reports specified on drawings.

1.06 QUALITY ASSURANCE

A. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or referenced standards.

1. GANA Publications
2. AAMA Publications

B. Safety glass products in the US are to comply with CPSC 16 CFR Part 1201 for Category II materials.

C. Single-source fabrication responsibility: All glass fabricated for each type shall be processed and supplied by a single fabricator.

1.07 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instruction for receiving, handling, storing and protecting glass & glazing materials.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.

E. Where insulating glass units will be exposed to substantial altitude changes, comply with insulating glass fabricator's recommendations of venting and sealing.

1.08 PROJECT / SITE CONDITIONS

A. Field Measurements: When construction schedule permits, verify field measurements with drawing dimensions prior to fabrication of glass products.

1.09 WARRANTY

A. Provide written 5-year warranty from date of manufacture for PVB laminated glass. Warranty covers deterioration due to normal conditions of use and not to handling installing, protecting and maintaining practices contrary to glass manufacturer's published instructions.

B. Provide a written warranty from date of manufacture for tempered glass.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer is used in this section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced standards.

1. Oldcastle BuildingEnvelope®
2. Pilkington
3. PPG Industries

2.1 GENERAL CRITERIA

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength:

1. Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
2. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic-protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTME 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For all glazing, regardless of height above grade.

2.2 GLASS PRODUCTS

A. Glass Identification:

1. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.
2. Etch manufacturer's label on each light of tempered glass.

B. Laminated Glass

1. Laminated Glass: ASTMC 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
    a. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
    b. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
    c. Interlayer Color: Clear unless otherwise indicated.
2. Windborne-Debris-Impact-Resistant Laminated Glass: ASTM C 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, with "Windborne-Debris-Impact Resistance" Paragraph in "Glass Products, General" Article, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
3. Construction: Laminate glass with the following to comply with interlayer manufacturer's written recommendations:
    a. Polyvinyl butyral interlayer.
4. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
5. Interlayer Color: Clear unless otherwise indicated.
6. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

C. Tempered Glass

1. Meet ASTM C 1048 for type listed.
2. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation.
3. Fabrication Tolerances: In accordance with ASTM C 1036 and C 1048.

D. Glazing Gaskets

1. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
    a. EPDM complying with ASTM C 864.
    b. Silicone complying with ASTMC 1115.
2. Thermoplastic polyolefin rubber complying with ASTMC 1115.

3. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

4. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

E. Glazing Sealants

1. General:

a. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

b. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

c. VOC Content: For all sealants used inside or outside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

d. Colors of Exposed Glazing Sealants: Black

2. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Omniseal 50.

b. Dow Corning Corporation; 791.

c. GE Advanced Materials - Silicones; SilPruf SCS2700.

d. Pecora Corporation; 895.

e. Tremco Incorporated; Spectrem 1.

F. Accessories:

1. Spacers, Setting Blocks and Glazing Gaskets: Meet ASTM C 864; neoprene or EPDM.

a. Spacers: 45 to 55 Shore A durometer.

b. Setting blocks: 75 to 85 Shore A 80 durometer.

c. Glazing gaskets: Non-cellular EPDM or neoprene, 65 to 75 Shore A durometer.

2. Glazing Sealant:

a. Sealant: General Electric NSilpruf" or accepted substitute.

b. Backer rod: Dow Corning Co. NEthafoamN or accepted substitute.

c. Primer: As recommended by glazing sealant manufacturer.

3. Glazing Tape: Preformed butyl rubber compound with integral resilient tube spacing device, Shore A 10 to 15 durometer hardness, coiled on release paper, black color.
4. Cleaners: As recommended by sealant or gasket manufacturer.
5. Laminating Film: One-part Uvecol UV curable polymer, minimum 60 mils thick, clear as manufactured by surface specialties or accepted substitute.

G. Glazing Unit Fabrication

1. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
2. Grind smooth and polish exposed glass edges and corners.

2.02 GLAZING TYPES

A. Glass Type GT-1: Laminated Glass Units

B. Location: At exterior storefront windows.

1. Glass Unit Makeup:
   a. Exterior Lite: Vitro 1/4" Solarban 70XL.
   b. Interlayer Material: 0.090• Clear Polyvinyl butyral.
   c. Interior Lite: Vitro ¼" Solar Gray.
2. Performance Characteristics (Center of Glass)
   a. Thermal
      1) Summer U-factor/U-value: 0.85
      2) Solar Heat Gain Coefficient: 0.24
      3) Shading Coefficient: 0.28
      4) Relative Heat Gain (Btu/hr-ft2): 67
      5) Light to Solar Gain: 1.24
   b. Optical
      1) Visible Light Transmittance: 30%
      2) Visible Light Reflectance (outside): 12%
      3) Visible Light Reflectance (inside): 18%
      4) Total Solar Transmittance: 8%
      5) Total Solar Reflectance (outside): 49%
      6) Ultraviolet Transmittance: <1%

C. Glass Type GT-2: Interior Glass Door Lites and Sidelites:

1. Type and Thickness: 5/16" laminated safety glass.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification and Conditions

1. Verify that site conditions are acceptable for installation of the glass.
2. Verify openings for glazing are correctly sized and within tolerance.
3. Verify that a functioning weep system is present.
4. Verify that the minimum required face and edge clearances are being followed.
5. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection

1. Handle and store product according to manufacturers' recommendations.

B. Surface Preparation

1. Clean and prepare glazing channels and other framing members to receive glass.
2. Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.

3.03 INSTALLATION

A. Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual."

B. Install glass in prepared glazing channels and other framing members.

C. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual and IGMA Glazing Guidelines.

D. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA Glazing Manual.

E. Provide weep system as recommended by GANA Glazing Manual.

F. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

G. Distribute the weight of the glass unit along the edge rather than at the corner.

H. Comply with manufacturer's and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and bite clearances, use of glass spacers, edge blocks and installation of weep systems.

I. Protect glass from edge damage during handling and installation.

J. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

K. Remove and replace glass that is broken, chipped, cracked or damaged in any way.

3.04 CLEANING

A. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

B. Glass to be cleaned according to:

1. GANA Glass Informational Bulletin GANA 01-0300 - Proper Procedures for Cleaning Architectural Glass Products.

2. GANA Glass Information Bulletin GANA TD-02-0402 - Heat-Treated Glass Surfaces Are Different.

C. Do not use scrapers or other metal tools to clean glass or door / window frame.

END OF SECTION 08 80 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SUBMITTALS

A. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

D. Low-Emitting Materials Requirements: Comply with requirements indicated in Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

E. Environmental Product Declaration Documentation including EPD's, product comparison documentation, third-party certification documentation and life cycle analysis documentation.

F. Health Product Declaration Documentation (HPD) on acoustic insulation.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.

1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Non-structural Steel Framing for Application of Gypsum Board: As specified in Section 092216.

2.03 BOARD MATERIALS

A. MOISTURE- AND MOLD-RESISTANT REGULAR AND TYPE X GLASS-MAT GYPSUM SHEATHING A. ASTM C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing, 5/8 in. (15.9 mm) Type X glass mat water-resistant gypsum substrate

1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: United States Gypsum Company, USG Securock® Brand UltraLight Glass-Mat Sheathing.

2. UL Type Designation: 5/8 in. (15.9 mm): “USGX”
3. ASTM E136 Non-combustibility: Meets
4. ASTM E84 Surface-Burning Characteristics
    a. Flame Spread: 5/8 in. (15.9 mm): 0
    b. Smoke Developed: 5/8 in. (15.9 mm): 0
    c. Class A (Flame spread not greater than 25 and smoke developed not greater than 450): Meets
5. ASTM C473, Standard Test Methods for Physical Testing of Gypsum Panel Products
    a. Core Hardness-Field: 5/8 in. [15.9 mm] Not less than 15 lbf (67 N): Meets
    b. Core Hardness-End: 5/8 in. [15.9 mm] Not less than 15 lbf (67 N): Meets
    c. Flexural Strength - Parallel: 5/8 in. [15.9 mm] Not less than 100 lbf (445 N): Meets}
    d. Flexural Strength - Perpendicular: 5/8 in. [15.9 mm] Not less than 140 lbf (623 N): Meets
    e. Nail Pull Resistance: 5/8 in. [15.9 mm] (Not less than 90 lbf (400 N): Meets
    f. Humidified Deflection: 5/8 in. [15.9 mm] (Not greater than 1/8 in. (3 mm)): Meets
    g. Average Water Absorption (Not greater than 10% by weight after two-hour immersion): Meets
6. ASTM D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber: 5/8 in. (15.9 mm): 10
7. Thickness: 5/8 in. (15.9 mm)
8. Length: 8-12 ft. (2438-3658 mm)
9. Width: 48 in. (1219 mm)
10. Weight: 5/8 in. (15.9 mm): 2.2 lb./sq. ft. (10.7 kg/sq. m.)
11. Edge: Square

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
    1. Certification: Greenguard Gold.
    2. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
    3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
    4. 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.
    5. Thickness:
        a. Vertical Surfaces: 5/8 inch (16 mm).

b. Ceilings: 5/8 inch (16 mm).

c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Backing Board For Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.

1. Certification: Greenguard Gold.
2. Application: Vertical surfaces behind thinset tile.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. 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.
5. Type: Regular and Type X, in locations indicated.
6. Type X Thickness: 5/8 inch (16 mm).
7. Regular Board Thickness: 5/8 inch (16 mm).
8. Edges: Tapered.

D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Certification: Greenguard Gold.
2. Application: Ceilings, unless otherwise indicated.
3. Thickness: 5/8 inch (16 mm).
4. Edges: Tapered.

2.04 GYPSUM WALLBOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch (76.2 mm).

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Finishing Accessories: ASTM C1047, galvanized steel, rolled zinc, or rigid plastic, unless noted otherwise.

1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Products:
3. Joint Compound: Drying type, vinyl-based, ready-mixed.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with GA-600 requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

3.03 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.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying 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 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
3. Level 3: Walls to receive textured wall finish.
4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.

5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
6. Level 0: Temporary partitions.
7. Level 0: Surfaces indicated to be finished in later stage of project.

END OF SECTION 09 21 16

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SUBMITTALS

A. Shop Drawings:

1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.

B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as indicated on drawings.

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).

1. Studs: C shaped.
2. Paired Studs for Sound-Rated Assemblies: Engineered single-piece assemblies comprised of paired studs coupled by sound isolators, designed to replace conventional side-by-side, parallel, double-wall partition framing.
   a. Widths: As indicated on drawings.
3. Runners: U shaped, sized to match studs.
4. Ceiling Channels: C shaped.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
6. Resilient Furring Channels: Single or double leg configuration; 1/2-inch (12 mm) channel depth.
7. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation for areas between gypsum board assemblies and adjacent sources of noise.

C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code in accordance with AISI S100- 12.
2. Seismic Performance: Comply with applicable code requirements and CISCA (SC) Seismic Construction Handbook, 2018.

3. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot-dipped galvanized coating.
4. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

D. Non-Loadbearing Framing Accessories:

1. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

E. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.

1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.02 **FABRICATION**

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 **INSTALLATION OF STUD FRAMING**

A. Comply with requirements of ASTM C754.

B. Extend partition framing to structure where indicated and to ceiling in other locations.

C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

D. Align and secure top and bottom runners at 24 inches (600 mm) on center.

E. Install studs vertically at spacing indicated on drawings.

3.02 **CEILING AND SOFFIT FRAMING**

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Space main carrying channels at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.

D. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

E. Laterally brace suspension system.

END OF SECTION 09 22 16

SECTION 09 24 00 – CEMENT PLASTERING

PART 1 GENERAL

1.1 SUBMITTALS

A. Product Data: Provide data on plaster materials, substrate bonding agent, and trim and finish accessories.

PART 2 PRODUCTS

2.1 JOBSITE MIXED CEMENT PLASTER

A. Fire Resistance Rating: Determined in accordance with test procedures in ASTM E119.

B. Materials:

1. Portland Cement: ASTM C150/C150M, Type I.
    a. Finish Coat: Gray color.
2. Masonry Cement: ASTM C91/C91M, Type N.
3. Plastic Cement: ASTM C1328/C1328M.
4. Lime: ASTM C206 Type S or ASTM C207 Type S.
5. Sand: Clean, well graded, and complying with ASTM C897.
6. Water: Clean, fresh, potable, and free of mineral or organic matter that could adversely affect plaster.

C. Plaster Mixes: Proportioned in accordance with ASTM C926; parts by volume.

1. First Coat Over High Absorption Solid Base:
    a. Plaster Mix "CL": One part Portland cement, with minimum 3/4 part and maximum 1-1/2 parts hydrated lime.
    b. Plaster Mix "M": One part Type N masonry cement.
    c. Plaster Mix "P": One part plastic cement.
    d. Minimum 2-1/2 parts and maximum 4 parts sand, per total volume of cementitious materials.
2. First Coat Over Low Absorption Solid Base:
    a. Plaster Mix "C": One part Portland cement, with minimum zero part and maximum 3/4-part hydrated lime.
    b. Plaster Mix "CM": One part Portland cement, and one part Type N masonry cement.
    c. Plaster Mix "P": One part plastic cement.
    d. Minimum 2-1/2 parts and maximum 4 parts sand, per total volume of cementitious materials.

3. Second Coat: Same mixture as first coat, without fiber reinforcement, except minimum 3 parts and maximum 5 parts sand.

4. Finish Coat:

   a. Plaster Mix "F": One part Portland cement, with minimum 3/4 part and maximum 1-1/2 parts hydrated lime.

   b. Minimum 1-1/2 parts and maximum 3 parts sand, per total volume of cementitious materials.

2.2 ACCESSORIES

A. Bonding Compound: Provide type recommended for bonding plaster to solid surfaces, complying with ASTM C932.

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify masonry joints are flush and surfaces are ready to receive work of this section, and that there are no existing bituminous or water repellent coatings on masonry surfaces.

C. Verify concrete surfaces are flat, honeycombs are filled flush, and surfaces are ready to receive work of this section, and that there are no existing bituminous, water repellent, or form release agent coatings on concrete surfaces that may be detrimental to plaster bond

3.2 MIXING

A. Mix only as much plaster as can be used prior to initial set.

B. Mix materials dry, to uniform color and consistency, before adding water.

3.3 APPLICATION

A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.

END OF SECTION 09 24 00

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

C. Sustainable Materials Submittal Requirements: Comply with requirements indicated in Section 018113 - Sustainable Design Requirements - Green Globes NC.

D. Low Emitting Materials Submittal Requirements: Comply with requirements indicated in Section 016116 - Volatile Organic Compound (VOC) Content Restrictions. Submit VOC content documentation for adhesives and waterproofing membranes.

E. Environmental Product Declaration Documentation including EPDs, product comparison documentation, third-party certification documentation and life-cycle analysis documentation.

F. Health Product Declaration Documentation including HPDs, third-party certification documentation, cradle to cradle material health certificates documentation.

G. Samples: For color selection.

1.02 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: Refer to Architectural Drawings for information on product type, model, color, and manufacturer.

B. Glazed Wall Tile: ANSI A137.1 standard grade.

1. Size: 3 by 6 inch (152 by 406.4 mm) nominal.

2. Surface Finish: High gloss.

C. Porcelain Tile: ANSI A137.1 standard grade.

1. Size: 24 by 24 inch (304.8 by 609.6 mm), nominal.

2. Thickness: 3/8 inch (9.5 mm).

3. Edges: Cushioned.

4. Surface Finish: Matte Non-slip, with a Dynamic Coefficient of Friction of Hard Surface Flooring Materials of .60 per ANSI A326.3.

D. Porcelain Tile: ANSI A137.1 standard exterior grade.

1. Size: 24 by 24 inch (304.8 by 609.6 mm), nominal.

2. Thickness: 3/8 inch (9.5 mm).

3. Edges: Cushioned.

4. Surface Finish: Textured Non-slip Surface Finish with a minimum Dynamic Coefficient of Friction of Hard Surface Flooring Materials of .60 per ANSI A326.3.

2.02 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.

1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.

2.03 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.

1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.

2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.

2.04 TRIM AND ACCESSORIES

A. Basis-of-Design Products: Subject to compliance with the requirements provide the products listed below or comparable products by another manufacture.

1. Top of Wainscot Termination (NOT USED):

a. Provide: RONDEC-DB by Schluter.

2. Metal Cove Floor to Wall Transition: Inside and outside corners to match straight profile.

b. Provide DILEX-AHK by Schluter

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. Material: Artificial stone tile; 93 percent quartz aggregate, resin, color pigments.

2. Color and Pattern: As indicated on drawings.

2.05 ACCESSORY MATERIALS

A. Waterproofing Membrane at Showers and Other Tiled Wet Areas: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.

1. Fluid or Trowel Applied Type:

    a. Material: Synthetic rubber.

    b. Thickness: 12 mils (0.3 mm), minimum, dry film thickness.

B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch (12.7 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.

C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install tile and thresholds 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. Do not interrupt tile pattern through openings.

3.02 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over exterior concrete substrates, install in accordance with TCNA (HB) Method F102, with high performance polymer modified grout.

B. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with high performance polymer modified grout, unless otherwise indicated.

1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.03 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms, kitchens, and wet areas.

B. 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, unless otherwise indicated.

1. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCNA (HB) Method W222, one coat method.

C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

END OF SECTION 09 30 00

SECTION 09 51 00 – ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Low-Emitting Materials Submittal Requirements: Comply with requirements indicated in Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

D. Environmental Product Declaration Documentation including EPD's, product comparison documentation, third-party certification documentation and life cycle analysis documentation.

1.2 QUALITY ASSURANCE

A. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

1.3 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 50 percent prior to, during, and after acoustical unit installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119.

B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:

1. Local authorities having jurisdiction.

2. CISCA (SC) Seismic Construction Handbook 2018.

2.2 METAL SUSPENSION SYSTEMS

A. Components:

1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

2. Structural Classification: ASTM C 635 Heavy Duty.

3. Color: Blizzard White and match the actual color of the selected ceiling tile, unless noted otherwise.
4. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
5. Acceptable Product: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries
    a. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
6. Wire for Hangers and Ties:
    a. ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.
7. Edge Moldings and Trim:
    a. 10ft Seismic Shadow Molding
8. Accessories:
    a. BERC-2 - Beam End Retaining Clip. Install at each tee and cross-tee at edge molding. Affix BERC clip to wall on two sides of room, leaving the remaining clips to move freely.

2.3 ACOUSTICAL PANELS

A. Acoustical Tiles, Type ACT-1: Subject to compliance with requirements, provide Radar Clima-Plus #2220 by USG 24 x 24 inch acoustic panels.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern.

2.4 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
2. Pecora Corporation; BA-98.
3. Tremco, Inc.; Tremco Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. A. Install after major above-ceiling work is complete.

B. B. Coordinate the location of hangers with other work.

C. C. Provide hanger clips and additional hangers and inserts as required.

3.2 INSTALLATION – SUSPENSION SYSTEM

A. A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

3.3 INSTALLATION – ACOUSTICAL UNITS

A. A. Install acoustical units in accordance with manufacturer's instructions.

B. B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

END OF SECTION 09 51 00

SECTION 09 90 00 – PAINTING AND COATING

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 work of this section.

1.2 SUMMARY

A. This section includes:

1. Interior painting.
2. Exterior painting.

B. Work includes:

1. Painting and finishing of interior and exterior exposed elements, items and surfaces throughout project, except as otherwise indicated.
2. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
3. Work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.

C. Surfaces to be painted:

1. Except where natural finish of materials is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in “schedules.”
2. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.

D. Following categories of work not included as part of field-applied finish work:

1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, architectural woodwork and casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and distribution cabinets.
2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.

3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finished painting.

4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, and motor and fan shafts will not require finished painting.

5. The following categories of work are included under other sections of these specifications.

6. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.

7. Unless otherwise specified, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.

E. Do not paint over any code-required labels, such as Underwriters, Laboratories or any equipment identification, performance rating, name, or nomenclature plates.

1.3 RELATED SECTIONS

A. Section 01 81 15 VOC Limits for Adhesives, Sealants, Paints, and Coatings: VOC limits for paints and coatings.

B. Section 05 50 00 Metal Fabrications: Shop priming of metal substrates with primers specified in this Section.

C. Section 06 10 53 Rough Carpentry: Shop priming carpentry with primers specified in this Section.

D. Section 08 11 13 Hollow Metal Doors and Frames: Factory priming hollow metal doors and frames with primers specified in this Section.

A. Section 26 42 00 Cathodic Protection: Shop and field applied coatings that provide passive cathodic protection for insulated and uninsulated iron and steel piping and joinery.

1.4 REFERENCES

A. CHPS Low Emitting Materials Criteria – Collaborative for High School Performance criteria based on CDHS section 01350 Standard Practice.

B. MPI – Master Paints Institute Standards

C. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition; www.aqmd.gov.

D. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

E. US EPA Reference Method 24 – Determination of Volatile matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating, Code of Federal Regulations Title 40, Appendix A, utilizing Procedure B of ASTM Method D2369.

1.5 SUBMITTALS

A. Submit "letter of conformance" according to Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product provide manufacturer's data. Include preparation requirements and application instructions.

C. Samples for Initial Selection: Submit manufacturer's standard color charts in form of actual acoustical units, including accessories, showing full range of colors and patterns available, for each type of unit indicated.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Product information for architectural paints, primers and coatings, including printed statement VOC content in g/L, and MSDS sheet.

E. Warranty: Provide from manufacturer a [10] year warranty against manufacturing defects.

F. Product Schedule: Use same designations indicated on Drawings.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.

2. Fed. Spec. number.

3. Manufacturer's stock number and date of manufacturer.

4. Manufacturer's name.

5. Contents by volume, for major pigment and vehicle constituents.

6. Thinning instructions.

7. Application instructions.

8. Color name and number.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.

C. Protect from the weather where necessary. Keep the storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

D. Follow the installation sequence and storage practices specified in Section 01 81 19 – Indoor Air Quality (IAQ) Management.

1.8 **FIELD CONDITIONS**

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are below 90 deg. F (32 deg. C), unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperature are below 95 deg. F (35 deg. C), unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in rain, fog or mist, or when relative humidity exceeds 85%, at temperature less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and within temperature and humidity limits specified by paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. Substitute products will only be considered in specific conditions that require the use of paints and coatings not previously specified in the Owner's standards manual.

1. Sherwin Williams

2. PPG Coatings

2.2 **MATERIALS**

A. General Criteria

1. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

2. Standards: MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its “MPI Green Performance Standard".

3. Material Compatibility:

   a. Provide materials for use within each paint system that are compatible with one another, and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

   b. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

4. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

5. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

B. Performance Criteria

1. Lead content in pigment, if any, is limited to contain no more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.

2. VOC Content: Comply with the requirements of Section 01 81 16 VOC Limits for Adhesives, Sealants, Paints, and Coatings.

C. Basis of Design: Interior Products

1. Block Fillers: Latex, Interior/Exterior: MPI #4.

2. Primers/Sealers:

   a. Primer Sealer, Latex, Interior: MPI #50.

   b. Primer, Latex, for Interior Wood: MPI #39.

3. Metal Primers:

   a. Primer, alkyd, anti-corrosive, for metal: MPI #79.

   b. Primer, alkyd, quick dry, for metal: MPI #76.

4. Water-Based Paints:

   a. Latex, Interior, (Gloss Level 3): MPI #52.

   b. Latex, Interior, Institutional Low Odor / VOC, Semi-Gloss (Gloss Level 5): MPI #147.

   c. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.

5. Solvent-Based Paints:
    a. Alkyd, Interior, (Gloss Level 3): MPI #51.
6. Epoxy Coatings
    a. Epoxy, Semi-Gloss: MPI #77.

PART 3 - EXECUTION

3.1 INSPECTION

A. Applicator must examine substrates and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

C. Starting painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

D. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

E. For interior applications:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    a. Gypsum Board: 12 percent.
2. Gypsum Board Substrates: Verify that the finishing compound is sanded smooth.
3. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. For exterior applications:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    a. Gypsum Board: 12 percent.
2. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

3.2 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition. Comply with recommendation in "MPI Manual" applicable to substrates indicated.

B. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

C. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

D. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

E. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulates. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

F. Concrete Substrates: Remove release agents, curing compound, efflorescence and chalk, and by roughening as required to remove glaze. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Clean concrete floor surfaces are scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush the floor with clean water to neutralize acid and allow drying before painting.

G. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

H. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

1. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

I. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum-based solvent.

J. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

K. Wood Substrates:

1. Scrape and clean knots and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before use.

3.4 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions and recommendations in "MPI Manual."

1. Use applicators and techniques best suited for substrate and type of material being applied.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint the front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Paint colors, surface treatments, and finishes, as indicated in "schedules" of the contract documents.
    a. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
6. Provide finished coats which are compatible with prime paints used.
7. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

8. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

9. Finish doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.

10. Sand lightly between each succeeding enamel and/or varnish coat.

11. Omit the first coat (primer) on metal surfaces which have been shop-primed, and touch-up painted, unless otherwise indicated.

12. 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.

B. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed:

a. Un-insulated metal piping.

b. Pipe hangers and supports.

c. Metal conduit.

d. Tanks that do not have factory-applied final finishes.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

C. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

E. Prime Coats: Apply prime coat of material, which is required to be painted or finished, and which has not been prime coated by others.

1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first, coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

F. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

H. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

A. Sustainable Design:

A. VOC and chemicals of concern: Provide products that meet or exceed the paints and coatings requirements as specified in Section 01 81 15 VOC Limits for Adhesives, Sealants, Paints, and Coatings.

B. Indoor Air Quality:

1. Temporary ventilation: Provide temporary ventilation as specified in Section 01 81 19 – Indoor Air Quality (IAQ) Management, and as follows:

a. Ventilate area per the requirements of the IAQ Plan.

b. Provide a temperature range of 60 degrees F minimum to 90-degree F maximum continuously for minimum 72 hours.

c. Provide continuous ventilation during installation and for not less than the time recommended by the manufacturer for full drying or curing.

C. Waste Management: As specified in Section 01 74 20 – Waste Management and as follows:

1. Follow recycling procedures established on the Construction Waste Management Plan.

2. Reuse paint containers whenever possible or clean empty containers and recycle.

3.6 FIELD QUALITY CONTROL

A. The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:

1. Engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to the project site will be taken, identified and sealed, and certified in presence of Contractor.

B. Testing laboratory will perform appropriate tests for any or all of following characteristics:

1. Abrasion resistance

2. Apparent reflectivity

3. Flexibility

4. Wash ability

5. Absorption
6. Accelerated weathering.
7. Dry opacity
8. Accelerated yellowness.
9. Recoating
10. Skinning
11. Color retention
12. Alkali resistance
13. Quantitative materials analysis
14. Dry Film Thickness

C. If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

3.7 CLEANING AND PROTECTION

A. Clean-Up: At the end of each workday, remove discarded paint materials, rubbish, cans and rags at end of each workday from site. Recycle any plastic containers or other materials applicable to the Waste Management Plan.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

D. Provide “Cuidado Pintura Fresca” signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

E. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.8 PAINT SCHEDULE

A. **See project Architectural drawings for Paint Schedule.**

END OF SECTION 09 90 00

SECTION 10 28 00 - TOILET AND BATH 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.

B. Related Sections:

1. Section 08 80 00 "Glazing" for frameless mirrors.

2. Section 06 10 00 – “Miscellaneous Rough Carpentry” for wall mounted support blocking and backing.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.

2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

3. Material and finish descriptions.

4. Features and options that will be included in the Project.

5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

2. Identify products using designations indicated.

C. Maintenance Data: For toilet and bath accessories to be included in maintenance manuals.

D. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORY PRODUCTS

A. Refer to Architectural Drawings Bathroom Equipment and Fixture Schedule for specified product models and manufacturers.

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of two keys for each accessory to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Refer to the Architectural Drawings for toilet and bath accessory mounting heights.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate the final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

C. Operation and Maintenance Data: For fire extinguishers to be included in maintenance manuals.

D. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

B. Coordinate type, capacity and required connections of fire extinguishers mounted in owner's supplied equipment.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:

   a. Amerex Corporation.

   b. Ansul Incorporated; Tyco International Ltd.

   c. Badger Fire Protection; a Kidde company.

   d. J. L. Industries, Inc.; a division of Activar Construction Products Group.

   e. Larsen's Manufacturing Company.

3. Valves: Manufacturer's standard.

4. Handles and Levers: Manufacturer's standard.

5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 20-A:120-B:C, 20-lb (9.1-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS <FE>

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amerex Corporation.

   b. Ansul Incorporated; Tyco International Ltd.

   c. Badger Fire Protection; a Kidde company.

   d. J. L. Industries, Inc.; a division of Activar Construction Products Group.

   e. Larsen's Manufacturing Company.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

CONSTRUCTION GROUP, LLC

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

    a. Orientation: Vertical.

2.3 FIRE EXTINGUISHER CABINETS

A. Similar to ELITE (EL) Safeguard fire rated cabinet

1. Front: 16-gauge Stainless steel fronts with concealed SOSS hinges
2. Tub: 22 gauge cold rolled rust inhibiting phosphate treated steel with baked white enamel finish.
3. Handles: chrome D.
4. Glazing: Clear acrylic.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

of humps or hollows.

E. Finishing: Consolidate surface with power-driven floats as soon as topping can support equipment and operator. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate topping by power-driven trowel so no blisters develop. Continue troweling passes and re-straighten until surface is smooth and uniform in texture.

a. Finish surfaces to specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15, measured within 24 hours according to ASTM E 1155 (ASTM E 1155M) for a randomly trafficked floor surface.

F. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of topping, at locations indicated or as approved by Architect.

1. Coat face of construction joint with epoxy adhesive at locations where topping is placed against hardened or partially hardened topping.

G. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before topping develops random contraction cracks.

1. Form joints in topping over contraction joints in base slabs, unless otherwise indicated.

2. Construct contraction joints for a combined depth equal to topping thickness and not less than one- fourth of base-slab thickness.

3. Construct contraction joints for a depth equal to one-half of topping thickness, but not less than ½ inch (13 mm) deep.

3.4 PROTECTION AND CURING

A. General: Protect freshly placed topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying topping, but before float finishing.

C. Begin curing immediately after finishing topping. Cure by one or a combination of the following methods, according to topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with continuous water-fog spray or continuously water saturated absorptive cover. Cover topping surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12

inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.5 JOINT FILLING

A. Prepare and clean contraction joints and install epoxy joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install epoxy joint filler full depth of contraction joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.6 REPAIRS

A. Defective Topping: Repair and patch defective topping areas, including areas that have not bonded to concrete substrate.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform tests and to prepare test reports.

B. Sample Sets: At point of placement, testing and inspecting agency shall take a set of 3 molded-cube samples from the topping mix for the first 1,000 sq. ft. (93 sq. m) plus 1 set of samples for each subsequent 5,000 sq. ft. (464 sq. m) of topping, or fraction thereof, but not less than 6 samples for each day's placement. Samples shall be tested according to ASTM C 109/C 109M for compliance with compressive strength requirements.

END OF SECTION 03 35 20

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general duty valves common to several mechanical piping systems.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.

B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
B

1. Gate Valves:

    a. Crane Company; Valves and Fitting Division.
    b. Hammond Valve Corporation.
    c. Kitz Corp. of America.
    d. Lunkenheimer/Cincinnati Valve Co.
    e. Milwaukee Valve Company, Inc.
    f. NIBCO Inc.
    g. Powell: Wm. Powell Company (The).
    h. Red-White Valve Corp.
    i. Stockham Valves & Fittings, Inc.

2. Ball Valves:

    a. Conbraco Industries, Inc.; Apollo Division.
    b. Hammond Valve Corporation.
    c. Milwaukee Valve Company, Inc.
    d. NIBCO Inc.
    e. Stockham Valves & Fittings, Inc.
    f. Tyler Pipe.
    g. Victaulic Company of America.

3. Swing Check Valves:

    a. Cla-Val Co.
    b. Crane Company; Valves and Fitting Division.
    c. Hammond Valve Corporation.
    d. Kitz Corp. of America.
    e. Lunkenheimer/Cincinnati Valve Co.
    f. Milwaukee Valve Company, Inc.
    g. NIBCO Inc.
    h. Powell: Wm. Powell Company (The).
    i. Red-White Valve Corp.
    j. Stockham Valves & Fittings, Inc.
    k. Victaulic Company of America.

2.2 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Handwheels: For valves other than quarter turn.
2. Lever Handles: For quarter-turn valves 6 inches and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
3. Chain-Wheel Operators: For valves 4 inches and larger, installed 96 inches or higher above finished floor elevation.
4. Gear-Drive Operators: For quarter-turn valves 8 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. Threads: ASME B1.20.1.

H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.

I. Solder Joint: ASME B16.18.

1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

A. Gate Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

B. Gate Valves, 3 Inches and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with 2-piece packing gland assembly, flanged end connections; and with cast-iron handwheel.

2.4 BALL VALVES

A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:

1. Operator: Steel handwheel.
2. Stem Extension: For valves installed in insulated piping.
3. Memory Stop: For operator handles.

2.5 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap,

rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. For chain-wheel operators, extend chains to 60 inches above finished floor elevation.

H. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
3. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

3.7 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Gate Valves: Class 125, bronze or cast-iron body to suit piping system.

2. Ball Valves: Class 150, 600-psi CWP, with stem extension.
3. Plug Valves: Neoprene-faced plug, Buna N packing.
4. Globe Valves: Class 125, bronze or cast-iron body to suit piping system, and bronze or teflon disc.
5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
6. Bronze Swing Check: Class 125, with rubber seat.
7. Check Valves: Class 125, swing or wafer type as indicated.

C. Heating Water Systems: Use the following valve types:

1. Gate Valves: Class 150, bronze or cast-iron body to suit piping system.
2. Ball Valves: Class 150, 600-psi CWP, with stem extension and memory stop.
3. Plug Valves: Viton or teflon packing.
4. Globe Valves: Class 150, bronze or cast-iron body to suit piping system, and bronze disc.
5. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
6. Bronze Swing Check: Class 150, with composition seat.
7. Check Valves: Iron swing, wafer, or lift type, as indicated. Swing check shall be Class 150 with bronze seat ring.

3.8 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 220523

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 DEFINITIONS

A. Water Service Piping: Water piping outside building that conveys water to building.

B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping.

C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.

D. The following are industry abbreviations for plastic piping materials:

1. CPVC: Chlorinated polyvinyl chloride.
2. NP: Nylon.
3. PB: Polybutylene.
4. PE: Polyethylene.
5. PP: Polypropylene.
6. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Combined Fire-Protection and Domestic, Service Entrance Piping: 250 psig.
2. Service Entrance Piping: 160 psig.
3. Water Distribution Piping: 125 psig.
4. Service Entrance Piping: 100 psig.
5. Water Distribution Piping: 80 psig.

1.5 SUBMITTALS

A. Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water piping components. Include marking "NSF-pw" on plastic potable-water piping.

D. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

C. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

D. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80.

E. PVC Plastic Pipe: AWWA C900, Classes 150 and 200; with bell end with gasket, and spigot end.

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.

C. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

E. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.

AF. Schedule 80, PVC Socket Fittings: ASTM D 2467.

AG. Schedule 40, PVC Socket Fittings: ASTM D 2466.

AI. PVC Gasketed Fittings: AWWA C907, Class 150; with gaskets.

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.

C. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.

D. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.

E. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

F. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 VALVES

A. CPVC Plastic Valves: CPVC plastic body material similar to CPVC plastic piping system with seats, seals, and other components suitable for potable-water service. Comply with the following:

1. Ball Valves, 3-Inch NPS and Smaller: Union type with socket or threaded ends.
2. Check Valves, 4-Inch NPS and Smaller: Ball type with socket ends.

B. PVC Plastic Valves: PVC plastic body material with seats, seals, and other components suitable for potable-water service. Comply with the following:

1. Ball Valves: Union type with socket or threaded ends.
2. Check Valves, 2-Inch NPS and Smaller: Diaphragm or ball type with threaded or socket ends.
3. Check Valves, 3-Inch NPS and Larger: Swing or ball type with flanged ends.

C. PVC Plastic Valves: PVC plastic body material similar to PVC plastic piping system with seats, seals, and other components suitable for non-potable-water service. Comply with the following:

1. Ball Valves: Union type with socket or threaded ends.
2. Check Valves, 2-Inch NPS and Smaller: Diaphragm or ball type with threaded ends.
3. Check Valves, 3-Inch NPS and Larger: Swing or ball type with flanged ends.
4. Gate Valves: Nonrising-stem type with flanged ends.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.

D. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:

1. 2-Inch NPS and Smaller: Soft copper tube, Type K; copper, solder-joint pressure fittings; and soldered joints.
2. 2-1/2- to 3-1/2-Inch NPS: Soft copper tube, Type K; copper, solder-joint pressure fittings; and soldered joints.
3. 4- to 8-Inch NPS: Ductile-iron pipe and fittings, and mechanical or push-on joints.
4. 10- and 12-Inch NPS: Ductile-iron pipe and fittings, and mechanical or push-on joints.

E. Aboveground, Water Distribution Piping: Use the following:

1. 1-1/2-Inch NPS and Smaller: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
2. 2-Inch NPS: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
3. 2-1/2- to 3-1/2-Inch NPS: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
4. 4- to 6-Inch NPS: Hard copper tube, Type L with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
5. 4- to 6-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.
6. 4- to 6-Inch NPS: Ductile-iron pipe and fittings with grooved ends and ductile-iron, keyed couplings.
7. 8-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.
8. 10- and 12-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.

F. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:

1. 2-Inch NPS and Smaller: Hard copper tube, Type L; wrought-copper, solder-joint pressure fittings; and soldered joints.
2. 2-1/2- to 4-Inch NPS: Hard copper tube, Type L; wrought-copper, solder-joint pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

B. Grooved-end butterfly valves may be used with grooved-end piping.

C. Plastic gate, globe, ball, butterfly, and check valves may be used with plastic piping.

3.4 PIPING INSTALLATION, GENERAL

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION

A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building. Refer to Division 2 Section "Water Systems" for water service piping.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe.

C. Ductile-Iron, Service Entrance Piping: Comply with AWWA C600. Install buried piping between shutoff valve and connection to water service piping with restrained joints. Anchor pipe to wall or floor at entrance. Include thrust-block supports at vertical and horizontal offsets.

1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

E. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.6 WATER DISTRIBUTION PIPING INSTALLATION

A. Install piping with 0.25 percent slope downward toward drain.

B. Install piping level without pitch.

C. Fitting Option for Hard Copper Tube: Mechanically formed tee-branch outlets may be used instead of tee fittings.

3.7 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube, drill pilot hole, form collar for outlet, dimple tube forming seating stop, and braze branch tube into collar.

C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. Solvent-Cemented, Thermoplastic Pipe and Fitting Joints: Handle cleaners, primers, and solvent cements according to ASTM F 402.

3.8 VALVE INSTALLATION

A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.

B. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.

C. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Use ball valve for piping 2-inch NPS and smaller and butterfly valve for piping 2-1/2-inch NPS and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.

E. Calibrated Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

3.9 HANGER AND SUPPORT INSTALLATION

A. Install supports according to Division 15 Section "Hangers and Supports."

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. 3/4-Inch NPS and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
2. 1-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
3. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
4. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
5. 2-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
6. 3-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
7. 3-1/2-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
8. 4- and 5-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
9. 6-Inch NPS: Maximum horizontal spacing, 10 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
10. 8-Inch NPS: Maximum horizontal spacing, 10 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 10 feet.

E. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:

1. 2-Inch NPS and Smaller: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
2. 2-1/2- to 3-1/2-Inch NPS: Maximum horizontal spacing, 48 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 48 inches.
3. 4- and 5-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
4. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
5. 8-Inch NPS: Maximum horizontal spacing, 48 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:

1. Booster Systems: Connect cold-water suction and discharge piping.
2. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
4. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS and larger.

3.11 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:

B. Inspect service entrance piping and water distribution piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. 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.

    a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Test water distribution piping as follows:

D. Test service entrance piping and water distribution piping 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 water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. 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 to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
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.

3.12 CLEANING

A. Clean and disinfect potable-water distribution piping as follows:

B. Clean and disinfect potable service entrance piping and water distribution piping as follows:

C. Clean and disinfect water distribution piping as follows:

D. Clean and disinfect service entrance piping and water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of 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 3 hours.

c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

E. Prepare and submit reports for purging and disinfecting activities.

F. Clean interior of piping system. Remove dirt and debris as work progresses.

3.13 COMMISSIONING

A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

B. Perform the following steps before putting into 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 plugs used 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 that cartridges are clean and ready for use.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

E. Energize pumps and verify proper operation.

END OF SECTION 221116

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.

1.3 DEFINITIONS

A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.

B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building.

C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping.

D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.

E. Force-Main Piping: Drainage piping, under pressure.

F. The following are industry abbreviations for plastic and other piping materials:

1. ABS: Acrylonitrile-butadiene-styrene.
2. EPDM: Ethylene-propylene-diene polymer, rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Systems: 10-foot head of water.
2. Storm Drainage Systems: 10-foot head of water.
3. Sewage, Force-Main Piping Systems: 100 psig.

1.5 SUBMITTALS

A. Test Results and Reports: Specified in "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Ductile-Iron Pipe: AWWA C151 with mechanical- or push-on-joint bell and plain spigot end, unless plain, grooved, or flanged ends are indicated.

C. PVC Plastic Pipe: ASTM D 2665, Schedule 40.

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Aboveground, Soil, Waste, and Vent Piping: Use the following:

1. 1-1/4- and 1-1/2-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
6. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, Soil, Waste, and Vent Piping: Use the following:

1. 1-1/2-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
6. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

E. Aboveground, Storm Drainage Piping: Use the following:

1. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

F. Underground, Storm Drainage Piping: Use the following:

1. 3- and 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

G. Aboveground, Sewage Force Mains: Use the following:

1. 2- to 4-Inch NPS: Galvanized steel pipe and cast-iron, threaded fittings.
2. 5- and 6-Inch NPS: Galvanized steel pipe and cast-iron, threaded fittings.

H. Underground, Sewage-Force-Main, Service Entrance Piping: Use the following:

1. 4- and 6-Inch NPS: Ductile-iron pipe; ductile-iron, mechanical- or push-on-joint fittings; rubber gaskets; and mechanical or push-on joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

B. Grooved-end butterfly valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION, GENERAL

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION

A. Refer to Division 2 Section "Sewerage and Drainage" for sanitary and storm sewer piping.

B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.

C. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.

D. Extend building sanitary drain, force-main piping and connect to sanitary sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.

E. Extend building storm drain, force-main piping and connect to storm sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.

F. Ductile-Iron, Force-Main, Service Entrance Piping: Comply with AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

H. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.6 DRAINAGE AND VENT PIPING INSTALLATION

A. 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."

B. Make changes in direction for 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 2 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 make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.

C. Lay buried building drain 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.

D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS and smaller; 1 percent downward in direction of flow for piping 4-inch NPS and larger.
2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Storm Building Drain: 1 percent downward in direction of flow.
4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install force mains at elevations indicated.

F. Install engineered, sanitary drainage and vent systems in locations indicated and as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Copper, Sovent, Single Stack: Comply with CDA 402/0, "Brass and Bronze Design Handbook, Single-Stack Plumbing System."
3. Cast-Iron, Sovent, Single Stack: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
4. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

G. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.

H. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.

I. Install ABS plastic drainage piping according to ASTM D 2661.

J. Install PVC plastic drainage piping according to ASTM D 2665.

K. Install underground, ABS and PVC plastic drainage piping according to ASTM D 2321.

3.7 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. PVC Piping Joints: Join drainage piping according to ASTM D 2665.

E. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.

3.8 VALVE INSTALLATION

A. Shutoff Valves: Install shutoff valve on each pump discharge and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.

B. Check Valves: Install swing check valve on each pump discharge, downstream from shutoff valve.

3.9 HANGER AND SUPPORT INSTALLATION

A. Install supports according to Division 15 Section "Hangers and Supports."

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:

1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
2. 3-Inch NPS: Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
3. 4- and 5-Inch NPS: Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
4. 6-Inch NPS: Maximum horizontal spacing, 60 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
5. 8- through 12-Inch NPS: Maximum horizontal spacing, 60 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
6. 15-Inch NPS: Maximum horizontal spacing, 60 inches with 1-inch minimum rod diameter; maximum vertical spacing, 15 feet.
7. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

E. Install hangers for steel and ductile-iron piping with the following maximum spacing and minimum rod diameters:

1. 1-1/4-Inch NPS: Maximum horizontal spacing, 84 inches; 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
2. 1-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
3. 2-Inch NPS: Maximum horizontal spacing, 10 feet with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
4. 2-1/2-Inch NPS: Maximum horizontal spacing, 11 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
5. 3-Inch NPS: Maximum horizontal spacing, 12 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
6. 4- and 5-Inch NPS: Maximum horizontal spacing, 12 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
7. 6-Inch NPS: Maximum horizontal spacing, 12 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
8. 8- through 12-Inch NPS: Maximum horizontal spacing, 12 feet with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
9. 14- through 18-Inch NPS: Maximum horizontal spacing, 12 feet with 1-inch minimum rod diameter; maximum vertical spacing, 15 feet.

F. Install hangers for ABS and PVC plastic piping with the following maximum spacing and minimum rod diameters:

1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
2. 4- and 5-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
3. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
4. 8- through 12-Inch NPS: Maximum horizontal spacing, 48 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.

3.11 FIELD QUALITY CONTROL

A. Inspect drainage and vent piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. 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.

    a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, 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 has been covered or concealed before it has been tested and approved.
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 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. 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 using new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
2. 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 to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.12 CLEANING AND PROTECTING

A. Clean interior of piping system. 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.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION 221316

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete equipment base construction requirements.
3. Equipment nameplate data requirements.
4. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
5. Nonshrink grout for equipment installations.
6. Field-fabricated metal and wood equipment supports.
7. Installation requirements common to equipment specification Sections.
8. Mechanical demolition.
9. Cutting and patching.
10. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. 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.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for following piping specialties:

1. Mechanical sleeve seals.
2. Identification materials and devices.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

E. Coordination drawings for access panel and door locations.

F. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:

1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:

   a. Planned piping layout, including valve and specialty locations and valve stem movement.
   b. Planned duct systems layout, including elbow radii and duct accessories.
   c. Clearances for installing and maintaining insulation.
   d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
   e. Equipment service connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Fire-rated wall and floor penetrations.
   h. Sizes and location of required concrete pads and bases.

2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.

B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where 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. ASME B16.20 for grooved, ring-joint, steel flanges.
3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

E. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20 percent maximum lead content.

F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements: Manufacturer's standard solvents complying with the following:

1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.

I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.

1. Inside Diameter: Closely fit around pipe, tube, and insulation.
2. Outside Diameter: Completely cover opening.
3. Cast Brass: One-piece, with set-screw.
    a. Finish: Rough brass.
    b. Finish: Polished chrome plate.
4. Cast Brass: Split casting, with concealed hinge and set-screw.
    a. Finish: Rough brass.
    b. Finish: Polished chrome plate.
5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
6. Stamped Steel: One-piece, with spring clips and chrome-plated finish.
7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
11. Cast-Iron Floor Plate: One-piece casting.

B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

    a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.

C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.

    a. Penetrating Pipe Deflection: 5 percent without leakage.
    b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
    c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
    d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.

5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

    a. Underdeck Clamp: Clamping ring with set-screws.

6. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.
7. PVC Plastic Pipe: ASTM D 1785, Schedule 40.
8. PE Plastic: Manufactured, reusable, tapered, cup-shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.4 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.

B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: An accessible and visible location.

C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch -high letters for ductwork and not less than 3/4-inch -high letters for access door signs and similar operational instructions.

1. Material: Fiberboard.
2. Material: Brass.
3. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.

D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.

F. Plastic Duct Markers: Manufacturer's standard laminated plastic, color coded duct markers. Conform to following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
6. Nomenclature: Include following:

a. Direction of air flow.
b. Duct service (supply, return, exhaust, etc.).
c. Duct origin (from).
d. Duct destination (to).
e. Design cfm.

G. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated.

1. Fabricate in sizes required for message.

2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16 inch, except as otherwise indicated.
5. Thickness: 1/8 inch, except as otherwise indicated.
6. Thickness: 1/16 inch for units up to 20 square inches or 8 inches long; 1/8 inch for larger units.
7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

H. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
7. Nomenclature: Include following, matching terminology on schedules as closely as possible:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.

8. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.

I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, 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. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping system.

B. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.

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 where specified.

2. Build sleeves into new walls and slabs as work progresses.
3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. PVC Pipe Sleeves: For pipes smaller than 6 inches.
b. Steel Pipe Sleeves: For pipes smaller than 6 inches.
c. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
d. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."

1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."

R. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6 inches.
2. Install cast-iron wall pipes for sleeves 6 inches and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

S. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

T. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.

U. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping."

V. Verify final equipment locations for roughing in.

W. Refer to equipment specifications in other Sections for roughing-in requirements.

X. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
5. 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 inside diameter. Join pipe fittings and valves as follows:

    a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
    c. Align threads at point of assembly.
    d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:

    a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
    b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
    c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
    d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
    e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
    f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.

    a. Plain-End Pipe and Fittings: Butt joining.
    b. Plain-End Pipe and Socket-Type Fittings: Socket joining.

Y. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: Complying with ASME A13.1.
2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot noninsulated pipes.
3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:

    a. Near each valve and control device.
    b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
    c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
    d. At access doors, manholes, and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.
    f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
    g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.

1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger

lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.

D. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

A. Refer to Division 9 Section "Painting" for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not 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 members.

C. Attach to substrates as required to support applied loads.

3.8 DEMOLITION

A. Disconnect, demolish, and remove work specified under Division 15 and as indicated.

B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

D. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.

E. Removal: Remove indicated equipment from the Project site.

F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.10 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230500

SECTION 230529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

A. Contractor to provide design for seismic restraint hangers and supports, for piping and equipment.

B. Contractor to provide design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of hanger and support.

C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.

G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

CONSTRUCTION GROUP, LLC

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69.

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

F. Install concrete inserts in new construction prior to placing concrete.

G. Install powder-actuated drive-pin fasteners 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. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

K. Support fire protection systems piping independent of other piping.

L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

O. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

4. Pipes 8 Inches and Larger: Include wood inserts.
5. Insert Material: Length at least as long as the protective shield.
6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe 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 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of 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 by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 230529

SECTION 230548 - MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

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 vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.

1.3 SUBMITTALS

A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:

1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.4 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the 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 vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.5 PROJECT CONDITIONS

A. Project seismic zone is 4 with a zone factor of 0.40.

B. Building Importance Factor: 1.5.

1.6 COORDINATION

A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Apex Molded Products Co.
4. B-Line Systems, Inc.
5. Bramec Corp.
6. California Dynamics Corp.
7. Cannon Fabrication, Inc.
8. Diversitech Corp.
9. Fabreeka International, Inc.
10. GMT International Corp.
11. Greene Rubber Co.
12. Isolation Technology, Inc.
13. Karman Rubber.
14. Kinetics Noise Control, Inc.
15. King, H.A., Ltd.
16. Lord Industrial Products.
17. Mason Industries, Inc.
18. Metalastik, Inc.
19. Minor Rubber Co., Inc.
20. Rubatex Corp.
21. Service Rubber Group, Inc.
22. Stock Drive Products.
23. Tech Products Corp.
24. Vibration Eliminator Co., Inc.
25. Vibration Isolation Co., Inc.
26. Wagner Products Corp.

2.2 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch thick and precompressed through 10 compression cycles at 3 times the rated load.
3. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
6. Top Plates: Provide threaded studs for fastening and leveling equipment.
7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 SEISMIC CONTROLS

A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

B. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.

1. Construction: Interlocking steel members restrained by a 3/4-inch-thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.

1. Construction: Welded steel shapes conforming to ASTM A 36.
2. Resilient Components: 3/4-inch-thick, replaceable, shock-absorbing neoprene insert.

2.4 VIBRATION ISOLATION BASES

A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.

1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
5. Configure inertia bases to accommodate equipment supported.
6. Pump Bases: Size to support pump and piping elbows.
7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.5 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.
1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.

B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.

C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

D. Fill concrete inertia bases, after installing base frame, with 3000-psig concrete, and trowel to a smooth, hard finish. Cast-in-place concrete is specified in Division 3.

E. Install pipe connectors at connections for equipment supported on vibration isolators.

3.2 SEISMIC CONTROL

A. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.

B. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.3 ADJUSTING AND CLEANING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.

B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. CTI: Cooling Tower Institute.

P. NEBB: National Environmental Balancing Bureau.

Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. Contract Documents examination report.
c. Testing, adjusting, and balancing plan.
d. Work schedule and Project site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."

E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

F. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

H. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

I. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

C. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine Architect's and Engineer's 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. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

S. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness 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 design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section. Or

B. 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" and this Section.

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

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 the airflow patterns from the outside-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.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.

2. Measure static pressure across each air-handling unit component.

    a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

6. 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

   a. Where sufficient space in submains 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. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:

1. Determine the balancing station with the highest percentage over design flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper

operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.9 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.10 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, 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.

B. Status Reports: As Work progresses, prepare 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.

3.14 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the 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, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
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 testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.

14. Test conditions for fans and pump performance forms, including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    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.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    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. Sheave dimensions, center-to-center and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data: Include the following:

    a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.

3. Test Data: Include design and actual values for the following:

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat coil static-pressure differential in inches wg.
    g. Cooling coil static-pressure differential in inches wg.

h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch.
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: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:

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. Sheave dimensions, center-to-center and amount of adjustments in inches.

2. Motor Data: Include the following:

a. 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. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:

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. Design airflow rate in cfm.
h. Design velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.

g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:

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: Include design and actual values for the following:

a. Airflow 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 psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230711 - MECHANICAL INSULATION

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 pipe and duct insulation.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 15 Section "Metal Ductwork" for duct lining.

1.3 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75 deg F.

D. Thermal resistivity is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.

E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.

F. Density: Is expressed in pcf.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

C. Samples of each type of insulation and jacket. Identify each sample describing product and intended use. Submit the following sizes of sample materials:

1. Board and Block Insulation: 12 inches square section.

2. Pre-Formed Pipe Insulation: 12 inches long, 2-inch NPS.

D. Material certificates, signed by the manufacturer, certifying that materials comply with specified requirements where laboratory test reports cannot be obtained.

E. Material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

B. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.

1. Interior and exterior equipment.
2. Interior and exterior duct systems.
3. Interior and exterior piping systems.
4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
5. Accepted mock-ups may become part of completed unit of Work.

1.6 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping and duct systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Glass Fiber:
   a. CertainTeed Corporation.
   b. Knauf Fiberglass GmbH.
   c. Manville.
   d. Owens-Corning Fiberglas Corporation.
   e. USG Interiors, Inc. - Thermafiber Division.
2. Flexible Elastomeric Cellular:
   a. Armstrong World Industries, Inc.
   b. Halstead Industrial Products.
   c. IMCOA.
   d. Rubatex Corporation.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.

1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
2. Density: 12 pcf average maximum.

D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.

1. Thermal Conductivity: 0.32 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.

E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.

1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
2. Density: 10 pcf average maximum.

F. Adhesive: Produced under the UL Classification and Follow-up service.

1. Type: Non-flammable, solvent-based.
2. Service Temperature Range: Minus 20 to 180 deg F.
3. Complies VOC requirements for adhesives. See Section 01 81 16 VOC limits for more information.

G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.

1. Tubular Materials: ASTM C 534, Type I.
2. Sheet Materials: ASTM C 534, Type II.

B. Thermal Conductivity: 0.30 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 INSULATING CEMENTS

A. Mineral Fiber: ASTM C 195.

1. Thermal Conductivity: 1.0 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
2. Compressive Strength: 10 psi at 5 percent deformation.

B. Expanded or Exfoliated Vermiculite: ASTM C 196.

1. Thermal Conductivity: 1.10 Btu x inch/h x sq. ft. x deg F average maximum at 500 deg F mean temperature.
2. Compressive Strength: 5 psi at 5 percent deformation.

C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.

1. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer that complies VOC requirements for adhesives. See Section 01 81 16 VOC limits for more information.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:

1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.

2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.

2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

2.7 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.

1. Tape Width: 4 inches.

2. Cloth Standard: MIL-C-20079H, Type I.

3. Tape Standard: MIL-C-20079H, Type II.

B. Wire: 14 gage nickel copper alloy, 16 gage, soft-annealed stainless steel, or 16 gage, soft-annealed galvanized steel.

C. Corner Angles: 28 gage, 1 inch by 1 inch aluminum, adhered to 2 inches by 2 inches kraft paper.

D. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.8 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.

2. Temperature Range: Minus 20 to 180 deg F.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.

1. Water Vapor Permeance: 0.02 perm maximum.

2. Temperature Range: Minus 50 to 250 deg F.

3. Color: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.

1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Install insulation with smooth, straight, and even surfaces.

F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.

J. Keep insulation materials dry during application and finishing.

K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:

1. Fibrous glass ducts.
2. Metal ducts with duct liner.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
5. Flexible connectors for ducts and pipes.
6. Vibration control devices.
7. Testing laboratory labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air distribution systems.
10. Fire protection piping systems.
11. Sanitary drainage and vent piping.
12. Drainage piping located in crawl spaces, unless indicated otherwise.
13. Below grade piping.

14. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.

15. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints. Bond with adhesive.

B. Stagger joints on double layers of insulation.

C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

D. Apply insulation with a minimum number of joints.

E. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.

3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.

a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.

4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.

6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.

H. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7 Section "Joint Sealants."

I. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to Division 7 for firestopping and fire-resistant joint sealers.

J. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

K. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.

1. Use same material and thickness as adjacent pipe insulation.
2. Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.
3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
4. Insulate elbows and tees smaller than 3 inches pipe size with premolded insulation.
5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
7. Cover insulation, except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

L. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 15 Section "Supports and Anchors." For cold surface piping, extend insulation on anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.5 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

1. Miter cut materials to cover soldered elbows and tees.
2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.6 DUCT INSULATION

A. Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

1. Smaller Than 24 Inches: Bonding adhesive applied in 6 inches wide transverse strips on 12 inches centers.
2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
3. Overlap joints 3 inches.
4. Seal joints, breaks, and punctures with vapor barrier compound.

3.7 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3 inch wide butt strips at end joints.

1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

B. Interior Exposed Insulation: Install continuous glass cloth jackets.

C. Install metal jacket with 2 inches overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

D. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2 inch overlap at joints. Embed glass cloth between (2) 1/16 inch thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

3.8 FINISHES

A. Paint finished insulation as specified in Division 9 Section "Painting."

B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.9 APPLICATIONS

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Domestic hot water.
2. Recirculated hot water.
3. Low-temperature hydronic (0 to 34 deg F).

4. Refrigerant suction.
5. Hydronic piping (35 to 99 deg F).
6. Hydronic piping (100 to 250 deg F).
7. High-temperature hydronic, steam, and condensate (250 to 350 deg F).
8. High-temperature hydronic, steam, and condensate (350 to 450 deg F).
9. Diesel engine exhaust.

C. Interior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Domestic hot water.
2. Low-temperature hydronic (0 to 34 deg F).
3. Refrigerant suction.
4. Chilled water (35 to 55 deg F).
5. Hydronic piping (35 to 99 deg F).
6. Hydronic piping (100 to 250 deg F).
7. High-temperature hydronic, steam, and condensate (250 to 350 deg F).
8. High-temperature hydronic, steam, and condensate (350 to 450 deg F).
9. Diesel engine exhaust.

D. Exterior, Exposed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant suction.
2. Hydronic piping (35 to 99 deg F).
3. Diesel engine exhaust.

E. Exterior, Concealed Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant suction.
2. Hydronic piping (35 to 99 deg F).
3. Diesel engine exhaust.

F. Duct Systems: Unless otherwise indicated, insulate the following duct systems:

1. Interior concealed supply, return and outside air ductwork.
2. Interior exposed supply, return and outside air ductwork.
3. Exterior exposed supply and return ductwork.
4. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.

3.10 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water and Storm Water All Sizes (Interior): 1/2 inch thick glass fiber, cellular glass, or flexible elastomeric insulation. Field-applied jacket is not required.

INTERIOR DOMESTIC HOT WATER AND RECIRCULATED HOT WATER

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1/2	NO	NONE
	CELLULAR GLASS	1	NO	NONE
	FLEXIBLE ELASTOMERIC	1/2	NO	NONE
1-1/2 TO 4	GLASS FIBER	1/2	NO	NONE
	CELLULAR GLASS	1	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE
5 TO 10	GLASS FIBER	3/4	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE
12 TO 36	GLASS FIBER	1	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	FLEXIBLE ELASTOMERIC	3/4	NO	NONE

INTERIOR LOW-TEMPERATURE HYDRONIC (0 TO 34 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
5 TO 10	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
12 TO 36	GLASS FIBER	2	YES	NONE
	CELLULAR GLASS	2	YES	NONE

INTERIOR REFRIGERANT SUCTION AND DUAL-TEMP HYDRONIC (35 TO 100 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	1	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE

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5 TO 10	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	1-1/2	YES	NONE
12 TO 36	GLASS FIBER	1-1/2	YES	NONE
	CELLULAR GLASS	2	YES	NONE

EXTERIOR REFRIGERANT SUCTION AND DUAL-TEMP HYDRONIC (35 TO 100 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	2	YES	(P)(A)(SS)
	CELLULAR GLASS	2	YES	(P)(A)(SS)
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
1-1/2 TO 4	GLASS FIBER	2	YES	(P)(A)(SS)
	CELLULAR GLASS	2-1/2	YES	(P)(A)(SS)
	FLEXIBLE ELASTOMERIC	3/4	YES	NONE
5 TO 10	GLASS FIBER	2-1/2	YES	(P)(A)(SS)
	CELLULAR GLASS	2-1/2	YES	(P)(A)(SS)
12 TO 36	GLASS FIBER	2-1/2	YES	(P)(A)(SS)
	CELLULAR GLASS	3	YES	(P)(A)(SS)

INTERIOR HYDRONIC (100 TO 250 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 4	GLASS FIBER	1	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE
	CALCIUM SILICATE	1-1/2	NO	(P)(K)(A)(SS)
5 TO 10	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(P)(K)(A)(SS)
12 TO 36	GLASS FIBER	2-1/2	NO	NONE
	CELLULAR GLASS	3	NO	NONE
	CALCIUM SILICATE	2-1/2	NO	(P)(K)(A)(SS)
1/2 TO 1-1/4 ONLY	FLEXIBLE ELASTOMERIC	3/4	NO	NONE

INTERIOR HYDRONIC AND L.P. STEAM (250 TO 350 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1-1/2	NO	NONE
	CELLULAR GLASS	2	NO	NONE
	CALCIUM SILICATE	1-1/2	NO	(P)(K)(A)(SS)

1-1/2 TO 4	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(P)(K)(A)(SS)
5 TO 10	GLASS FIBER	3	NO	NONE
	CELLULAR GLASS	3-1/2	NO	NONE
	CALCIUM SILICATE	3	NO	(P)(K)(A)(SS)
12 TO 36	GLASS FIBER	3-1/2	NO	NONE
	CELLULAR GLASS	4	NO	NONE
	CALCIUM SILICATE	3-1/2	NO	(P)(K)(A)(SS)

INTERIOR HYDRONIC AND H.P. STEAM (350 TO 450 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	2	NO	NONE
	CELLULAR GLASS	2-1/2	NO	NONE
	CALCIUM SILICATE	2	NO	(K)(A)(SS)
1-1/2 TO 4	GLASS FIBER	2-1/2	NO	NONE
	CELLULAR GLASS	3	NO	NONE
	CALCIUM SILICATE	2-1/2	NO	(K)(A)(SS)
5 TO 10	GLASS FIBER	3-1/2	NO	NONE
	CELLULAR GLASS	4	NO	NONE
	CALCIUM SILICATE	3-1/2	NO	(K)(A)(SS)
12 TO 36	GLASS FIBER	4	NO	NONE
	CELLULAR GLASS	4-1/2	NO	NONE
	CALCIUM SILICATE	4	NO	(K)(A)(SS)

INTERIOR HYDRONIC AND H.P. STEAM (350 TO 450 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	3	NO	(A)(SS)
	CELLULAR GLASS	3-1/2	NO	(A)(SS)
	CALCIUM SILICATE	3	NO	(A)(SS)
1-1/2 TO 4	GLASS FIBER	3-1/2	NO	(A)(SS)
	CELLULAR GLASS	4	NO	(A)(SS)
	CALCIUM SILICATE	3-1/2	NO	(A)(SS)
5 TO 10	GLASS FIBER	4-1/2	NO	(A)(SS)
	CELLULAR GLASS	5	NO	(A)(SS)
	CALCIUM SILICATE	4-1/2	NO	(A)(SS)
12 TO 36	GLASS FIBER	5	NO	(A)(SS)
	CELLULAR GLASS	5-1/2	NO	(A)(SS)
	CALCIUM SILICATE	5	NO	(A)(SS)

NOTE: INSTALL OVER FREEZE PROTECTION HEAT TRACING.

INTERIOR DIESEL ENGINE EXHAUST (INCLUDING SILENCER) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
1 TO 1-1/4	CELLULAR GLASS	3	NO	(A)(SS)
1-1/2 TO 4	CELLULAR GLASS	3-1/2	NO	(A)(SS)
5 TO 10	CELLULAR GLASS	4	NO	(A)(SS)
12 TO 36	CELLULAR GLASS	5	NO	(A)(SS)

3.11 DUCT SYSTEMS INSULATION SCHEDULE

INTERIOR CONCEALED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BLANKET	1-1/2	YES	NONE

INTERIOR EXPOSED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	1-1/2	YES	NONE
GLASS FIBER	PIPE - ROUND	1-1/2	YES	NONE

EXTERIOR CONCEALED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	2	YES	NONE
GLASS FIBER	PIPE - ROUND	2	YES	NONE
CELLULAR GLASS	BOARD - RECT.	3	YES	NONE
GLASS FIBER	PIPE - ROUND	3	YES	NONE
FLEXIBLE ELASTOMERIC	SHEET	2	YES	NONE

INTERIOR EXPOSED HVAC SUPPLY FANS, AIR HANDLING UNITS, CASING, AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD	2	YES	NONE

END OF SECTION 230711

CONSTRUCTION GROUP, LLC

SECTION 230900 - CONTROL SYSTEMS EQUIPMENT

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units that are not supplied with factory-wired controls.

1.3 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories connected to controllers to operate mechanical systems according to sequences of operation indicated or specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.

D. Shop Drawings containing the following information for each control system:

1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.
2. Each control device labeled with setting or adjustable range of control.
3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
7. Listing of connected data points, including connected control unit and input device.
8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
10. Software description and sequence of operation.

E. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Samples of each type of furnished thermostat cover according to requirements of Division 1.

G. Maintenance data for control systems equipment to include in the operation and maintenance manual specified in Division 1. Include the following:

1. Maintenance instructions and spare parts lists for each type of control device and compressed-air stations.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

H. Field Test Reports: Procedure and certification of pneumatic control piping system.

I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in control system installations.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.

C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.

D. Comply with NFPA 90A.

E. Comply with NFPA 70.

F. Coordinate equipment selection with Division 16 Section "Fire Alarm Systems" to achieve compatibility with equipment that interfaces with that system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

B. Replacement Materials: Provide one replacement diaphragm or relay mechanism for each unique pneumatic damper motor, valve motor, controller, thermostat, and positioning relay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Direct Digital Control (DDC) Systems and Components:

a. Alerton Technologies, Inc.
b. American Auto-Matrix, Inc.
c. Andover Controls Corp.
d. Automated Logic Corporation.
e. Barber-Coleman Co.; Environmental Controls.
f. Condyne Technology, Inc.
g. CSI Control Systems International, Inc.
h. Danfoss-EMC, Inc.
i. Demand Technologies, Inc.
j. EDA Controls Corp.
k. Electronic Systems USA, Inc.
l. Functional Devices Inc.
m. G C Controls, Inc.
n. Heat-Timer Corp.
o. Honeywell, Inc.; Commercial Buildings Group.
p. Integrated Energy Controls Corp.
q. Johnson Controls, Inc.; Controls Group.
r. Landis & Gyr Powers, Inc.
s. Luwa Bahnson Inc.
t. Pneuline Controls Co.
u. Robertshaw Controls Co.
v. Scientific-Atlanta; Control Systems Div.
w. Siebe Environmental Controls; Barber-Coleman/Robertshaw Products.
x. SnyderGeneral Corp.
y. Solidyne Corp.
z. Staefa Control System, Inc.
aa. TCS/BASYS Controls.
ab. Teletrol Systems Inc.
ac. Thorn Automated Systems, Inc.
ad. Trane Co. (The); Commercial Systems Group.
ae. Triangle MicroSystems, Inc.

2.2 DIRECT DIGITAL CONTROL (DDC) EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and back-up power source.

1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse input/output.
c. Monitoring, controlling, or addressing data points.
d. Testing and developing control algorithms without disrupting field hardware and controlled environment.

B. Local Area Networks (LANs): Not less than 60 stations or nodes at minimum 19.2 kB.

1. System Support: Capacity for a minimum of 10 workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

C. Software: Update to latest version of software at project completion. Include and implement the following capabilities from the control units:

1. Units of Measure: Inch-pound and SI metric.
2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
4. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
5. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

2.3 CONTROL PANELS

A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.

B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

1. Fabricate panels of 0.06-inch-thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color.
2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

C. Alarm Panels: Indicating light for each alarm point, single horn, ACKNOWLEDGE switch, and TEST switch, mounted in hinged-cover enclosure.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. ACKNOWLEDGE Switch: Horn silent and indicating light steady.
3. Second Alarm: Horn sounds and indicating light steady.
4. Alarm Condition Cleared: System reset and indicating light extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.4 ANALOG CONTROLLERS

A. Step Controllers: 6-stage or 10-stage type, with heavy-duty switching rated to handle loads, UL listed and operated by electric motor.

B. Electric Outdoor Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range -10 to 70 deg F, and single- or, double-pole contacts.

C. Electronic Controllers: Wheatstone bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing proportional control of motor speed from maximum to minimum of 55 percent (field adjustable). Provide ON-OFF action below minimum fan speed. Design controller to apply full voltage briefly when motor is started to bring motor up to minimum speed rapidly. Equip with filter circuit to eliminate objectionable radio interference.

E. Receiver Controllers: Single- or dual-input models with control-point adjustment direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, and authority adjustment. Provide proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal 3 to 13 psi.
2. Proportional band shall extend from 2-1/2 to 40 percent of primary sensor span, authority from 10 to 200 percent of primary sensor span.
3. Suitable for supply air pressure of 18 psi, input signal of 3 to 15 psi, and output signal 0 to 15 psi.

2.5 TIME CLOCKS

A. Seven-day, programming-switch timer with synchronous-timing motor and 7-day dial; continuously charged, nickel-cadmium-battery-driven, 8-hour, power-failure carryover; multiple-switch trippers; minimum of 2 and maximum of 8 signals per day with 2 normally open and 2 normally closed output contacts.

B. Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual ON-OFF-AUTO switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.

2.6 SENSORS

A. Electronic Sensors: Vibration and corrosion resistant, for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum.

a. Accuracy: Plus or minus 0.2 percent at calibration point.
b. Wire: Twisted, shielded-pair cable.
c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
d. Averaging Elements in Ducts: Use where ducts are larger than 9 sq. ft. or where prone to stratification, length as required.
e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
f. Room Sensors: Match room thermostats, locking cover.
g. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

2. Humidity Sensors: Bulk polymer sensor element.

a. Accuracy: 5 percent full range with linear output.
b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0 to 0.25 inch wg.
d. Duct Static-Pressure Range: 0 to 5 inches wg.

4. Pressure Transmitters: Direct acting for gas, liquid, or steam service, range suitable for system, proportional output 4 to 20 mA.

B. Pneumatic Transmitters: Vibration and corrosion resistant.

1. Space-Temperature Sensors: Linear-output type, 50 to 100 deg F range, with blank locking covers.
2. Room Return-Air Temperature Sensors: Linear-output type with bimetal sensing element and corrosion-proof construction, 50 to 100 deg F range, designed to be mounted in light troffers.
3. Duct-Mounted or Immersion-Type Temperature Sensors: Range as required for 3- to 15-psi output signal.
4. Temperature Transmitters: Rigid-stem type with bimetal sensing elements except where averaging is required, 3- to 15-psi output signal.

a. Averaging-Element Sensors: Single- or multiple-unit capillary elements.
b. Tamperproof Sensors: Corrosion-resistant construction, suitable for mounting on vibrating surface with exposed capillary protected with temperature-compensated armor or protective tubing.
c. Pipe-Mounted Temperature Sensing Elements: Rod-and-tube type for linear output, with separable wells filled with heat-conductive compound.

5. Space and Duct Humidity Transmitters: 1 pipe, directly proportional, with minimum sensing span of 15 to 75 percent, or 65 to 95 percent relative humidity for 3- to 15-psi output signal, corrosion resistant and temperature compensated, and with factory-calibrated adjustment.
6. Pressure Transmitters: Pressure sensor and transmitter of linear-output type, with range of 0 to 6 inches wg adjustable in 2-inch wg spans, 3- to 15-psi output. One pipe, direct acting for gas, liquid, or steam service.
7. Static-Pressure Transmitters: One pipe, direct acting, double bell, unidirectional with suitable range for expected input, temperature compensated.

a. Accuracy: 5 percent of full range and 2 percent of full-scale, midrange accuracy.
b. Output: 3 to 15 psi.

C. Equipment Operation Sensors: As follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psi.
3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

D. Digital-to-Pneumatic Transducers: Convert plus or minus 12-V dc pulse-width-modulation outputs, or continuous proportional current or voltage to 0 to 20 psi.

E. Valve/Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.

F. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.

2.7 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with 2-, 3-, or 4-position, push-button or lever-operated, fan switch.

1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on 2-gang switch box.

B. Low-Voltage, ON-OFF Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater.

C. Line-Voltage, ON-OFF Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual ON-OFF-AUTO selector switch; UL listed for electrical rating.

1. Equip thermostats, which control electric heating loads directly, with OFF position on dial wired to break ungrounded conductors.
2. Dead Band: Maximum 2 deg F.

D. Low-Voltage Modulating Thermostats: Potentiometer, operated by vapor-filled bellows.

E. Remote-Bulb Thermostats: ON-OFF or modulating type, liquid-filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. ON-OFF, remote-bulb thermostats with precision snap switches, with electrical ratings required by application.
6. Construct modulating, remote-bulb, potentiometer thermostats so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, with the following:

1. Reset: Manual.
2. Reset: Automatic with control circuit arranged to require manual reset at central control panel, with pilot light and reset switch on panel labeled to indicate operation.

G. Pneumatic Room Thermostats: 2-pipe, nonbleed or relay type, fully proportional with adjustable throttling range and tamperproof locking settings, direct or reverse acting as required, factory calibrated at 2.5 psi/deg F. Provide single or dual temperature as required by sequence of operations.

1. Set-Point Adjustment: Minimum 40 deg F set-point adjustment and adjustable dead band.
2. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower unoccupied setting, with manual reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.

H. Room Thermostat Construction: Manufacturer's standard locking covers.

1. Thermometer: Red-reading glass or spiral bimetal.
2. Guards: Heavy-duty, clear plastic or metal-wire, tamperproof guards.
3. Locking Covers: With only temperature indication visible.
4. Limits: Provide on heating/cooling dual-temperature thermostats, to prevent setting cooling set point below 75 deg F, and heating set point above 75 deg F.

I. Room Thermostat Accessories: As follows:

1. Insulating Bases: For thermostats located on exterior walls.
2. Thermostat Guards: Locking transparent-plastic mounted on separate base.
3. Adjusting Key: As required for device.
4. Aspirating Boxes: Where indicated for thermostats requiring flush installation.

J. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

K. Airstream Thermostats: 2-pipe, fully proportional, single temperature, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

L. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

M. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

N. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psi, cast housing with position indicator and adjusting knob.

2.8 HUMIDISTATS

A. Pneumatic Room Humidistats: Wall-mounted, proportioning type with adjustable throttling range (5 percent), 30 to 80 percent operating range, cover with finish matching room thermostats with set-point indication.

B. Duct-Mounted Humidistats: Electric insertion, 2-position type with adjustable 2 percent throttling range, 20 to 80 percent operating range, single- or double-pole contacts.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
2. Nonspring-Return Motors for Valves Larger Than 2-1/2 Inches: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
3. Spring-Return Motors for Valves Larger Than 2-1/2 Inches: Size for running and breakaway torque of 150 inch-pounds.
4. Nonspring-Return Motors for Dampers Larger Than 25 sq. ft.: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
5. Spring-Return Motors for Dampers Larger Than 25 sq. ft.: Size for running and breakaway torque of 150 inch-pounds.

B. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required. Select operator for full shutoff at maximum pump differential pressure.

C. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or 2-position action. Where actuators operate in sequence, provide pilot positioners.

1. Pilot Positioners: Starting point adjustable from 2 to 12 psi and operating span adjustable from 5 to 13 psi.
2. Inlet Vane Operators: High pressure with pilot positioners.

D. Electronic Operators: Select operator for full shutoff at maximum pump differential pressure.

2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.

B. Globe Pattern: As follows:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
3. Hydronic Systems: As follows:

a. Rating: Service at 125 psi WSP and 250 deg F.
b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.

1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
2) Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

c. Sizing: 3-psi maximum pressure drop at design flow rate.
d. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics. Select operators to close valves against pump shutoff head.

4. Steam Systems: As follows:

a. Rating: Service at 125 psi WSP and 250 deg F.
b. Internal Construction: Replaceable plugs and seats of stainless steel.

1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
2) Double-Seated Valves: Balanced plug; Cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

c. Sizing: 10-psi inlet pressure and 5-psi pressure drop.
d. Sizing: Pressure drop across steam valve at a maximum flow of 80 percent of inlet pressure for low-pressure systems and 42 percent for high-pressure systems.

e. Flow Characteristics: Modified linear characteristics.

C. Butterfly Pattern: Iron body; bronze, aluminum-bronze, or stainless-steel disc; resilient, replaceable seat for service to 180 deg F wafer or lug ends; extended neck.

1. Rating: Service at 125 psi WSP and 250 deg F.
2. Sizing: 1-psi maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Service at 125 psi WSP and 250 deg F.
2. Sizing: 3-psi maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics.
4. Operators (2 Position): Synchronous motor with enclosed gear train, dual-return springs, valve-position indicator. Valves spring return to normal position for temperature protection.
5. Operators (Modulating): Self-contained, linear motor, actuator with 60-second full travel, with transformer and single-throw, double-pole contacts.

2.11 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch galvanized steel, with maximum blade width of 8 inches.

1. Blades secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.
2. Operating Temperature Range: From -40 to 200 deg F.
3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.
4. For low-leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 inch-pounds; test in accordance with AMCA 500.

2.12 AIR SUPPLY

A. Control and Instrumentation Tubing: Seamless copper tubing; Type K, ASTM B 88 or Type ACR, ASTM B 280; with cast-bronze solder-joint fittings, ASME B16.18; or wrought-copper solder-joint fittings, ASME B16.22; soldered or brazed; except forged brass compression-type fittings at connections to equipment.

B. Control and Instrumentation Tubing: Virgin-polyethylene, flame-retardant, nonmetallic tubing, ASTM D 2737, and with flame-retardant harness for multiple tubing; compression or push-on polyethylene fittings.

C. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.

D. Duplex Air Compressor: Unit with automatic alternator to equalize running time of each unit, capacity to supply compressed air to temperature control system.

1. Pressure Control: Adjustable electric contacts, set to start and stop both compressors at different pressures.
2. Electrical Alternation Set: With motor starters and disconnect to operate compressors alternately or on time schedule.

E. Simplex Air Compressor: Tank-mounted compressor with capacity to supply compressed air to temperature control system, with starter and disconnect.

1. Pressure Control: Adjustable electric contacts, set to start and stop compressor.

F. Size compressor and tank to operate compressor not more than the following amount of time during a one-hour period:

1. Operating Time: 20 minutes.
2. Operating Time: 30 minutes.

G. Compressor Accessories: Equip with the following:

1. Low-resistance intake air filter.
2. Belt guards.

H. System Accessories: Equip with the following:

1. Air filter rated for 97 percent efficiency at rated air flow.
2. Combination filter/pressure-reducing station or separate filter and pressure-reducing station.

I. Refrigerated Air Drier: Self-contained, refrigerated air drier complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve.

1. Heat Exchangers: Air to refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.
2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F at 20 psi, housed in steel cabinet with access door and panel.
3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, ON-OFF switch, HIGH TEMPERATURE light, POWER ON light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, with contacts for remote indication of power status and high-temperature alarm.

J. Desiccant Drier: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F below inlet-air dew point at design conditions.

K. Pneumatic Accessories: As follows:

1. Pressure Gages: Manufacturer's standard, black letters on white background, 2-1/2-inch diameter, flush or surface mounted, with front calibration screw to match sensor, in appropriate units.
2. Instrument Pressure Gages: Manufacturer's standard, black letters on white background, 1-1/2-inch diameter, stem mounted, with suitable dial range.

3. Diaphragm Control and Instrument Valves: 1/4-inch forged brass body with reinforced teflon diaphragm, stainless-steel spring, and color-coded phenolic handle.
4. Gage Cocks: Tee or level handle, bronze, rated for 125 psi.
5. Relays: For summing, reversing, amplifying, highest or lowest pressure selection, with adjustable input/output ratio.
6. Switches: With indicating plates, accessible adjustment, calibrated and marked.

L. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve.

M. Particle Filters: Zinc or aluminum castings with filtration efficiency at rated air flow of 97 percent, quick-disconnect service devices, aluminum or plastic bowl with metal guard and manual drain cock.

N. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure build-up, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, aluminum or plastic bowl with metal guard and manual drain cock.

O. Airborne Oil Filter: Filtration efficiency of 99.9 percent for particles of 0.025 micrometer or larger particles of airborne lubricating oil.

P. Pressure-Relief Valves: ASME rated and labeled.

1. High Pressure: Size for installed capacity.
2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.

Q. Pressure-Reducing Stations: 2 parallel pressure regulators.

2.13 CONTROL CABLE

A. Electronic Cable for Control Wiring: Refer to Division 16 Section "Control/Signal Transmission Media."

B. Optical-Fiber Cable for Control Wiring: Refer to Division 16 Section "Control/Signal Transmission Media."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices, wiring, and pneumatic tubing are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment as indicated to comply with manufacturer's written instructions.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Mount compressor and tank unit on vibration isolation according to Division 15 Section "Vibration Control." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's recommendations and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, pressure-relief valve, with pressure gages, and shutoff and bypass valves.

E. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate 60 inches above floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

F. Provide guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

G. Install damper motors on outside of duct in warm areas, not where exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 15 Sections specifying mechanical identification.

I. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

J. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

L. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

M. Install optical-fiber cable according to Division 16 Section "Control/Signal Transmission Media."

3.3 CONTROL AIR PIPING

A. Mechanical Equipment Rooms: Inside mechanical equipment enclosures, in pipe chases, or suspended ceilings with easy access, install the following:

1. Copper tubing with maximum unsupported length of 36 inches, for tubing exposed to view.
2. Polyethylene tubing in metallic raceways or PVC pipe.

B. Terminal single-line connections less than 18 inches in length may be copper tubing, or polyethylene tubing run inside flexible steel protection.

C. Concealed locations, such as pipe chases, suspended ceilings with easy access, install copper or polyethylene bundled and sheathed tubing.

D. In concrete slabs, furred walls, or ceilings with no access, install copper or polyethylene tubing; install polyethylene tubing in EMT or vinyl-jacketed polyethylene tubing.

1. Protect embedded-copper and vinyl-jacketed polyethylene tubing with EMT extending 6 inches above finished slab and 6 inches into slab. Pressure test tubing before and after pour for leak and pinch.
2. Install polyethylene tube in EMT extending 6 inches above floor line; pull tubing into EMT after pour.

E. Purge tubing with dry, oil-free compressed air before connecting control instruments.

1. Bridge cabinets and doors with flexible connections, fastened neatly along hinge side; protect against abrasion. Tie and support tubing neatly.

F. Solder or braze copper tubing, except at instruments or equipment where compression fittings may be used.

G. Number-code or color-code control air piping, except local individual room control tubing, for future identification and servicing of control system.

H. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

3.4 ELECTRICAL WIRING AND CONNECTIONS

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways, Boxes, and Cabinets."

B. Install building wire and cable according to Division 16 Section "Wires and Cables."

C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where a number of cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
6. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

D. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

E. Connect manual reset limit controls independent of manual control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

F. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

3.5 FIELD QUALITY CONTROL

A. Pressure test control air piping at 30 psi or 1.5 times the operating pressure for 24 hours, with maximum 5-psi loss.

3.6 COMMISSIONING

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.

B. Test and adjust controls and safeties.

C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust control systems.

E. Demonstrate compliance with requirements.

F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.7 DEMONSTRATION

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Schedule training with Owner with at least 7 days' notice.
3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of 40 hours' dedicated instructor time on-site.

END OF SECTION 230900

SECTION 232300 - REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type and refrigerant piping specialty specified.

C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.

E. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual specified in Division 1 Sections and Division 15 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ASME B31.5, "Refrigeration Piping."
2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Refrigeration Oil Test Kits: 2 each, containing everything required to conduct 1 test.
2. Refrigerant: 2 containers each, with 20 lb of refrigerant.
3. Filter-Dryer Cartridges: 3 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Refrigerants:

a. Allied Signal Inc.; Genetron Refrigerants.
b. DuPont Company; Fluorochemicals Div.
c. Elf Atochem North America, Inc.
d. ICI Americas Inc.; Fluorochemicals Bus.

2. Refrigerant Valves and Specialties:

a. Danfoss Electronics, Inc.
b. Eaton Corporation; Industrial Control Div.
c. Emerson Electric Company; Alco Controls Div.
d. Henry Valve Company.
e. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
f. Sporlan Valve Company.

2.2 PIPES AND TUBES

A. Soft Copper Tube: ASTM B 88, Type L, annealed temper.

2.3 PIPE AND TUBE FITTINGS

A. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

B. Welding Materials: Comply with ASME Boiler and Pressure Vessel Code Section II, Part C, for welding materials appropriate for pipe being welded.

2.5 VALVES

A. Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature, globe or angle pattern, forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, with solder-end connections.

B. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature, forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, with solder-end connections.

C. Check Valves--Smaller than 1-Inch NPS: 500-psig operating pressure, 300 deg F operating temperature; cast-brass body, with removable piston, PTFE seat, and stainless-steel spring; straight-through globe design. Valve shall be straight-through pattern, with solder-end connections.

D. Check Valves--Larger than 1-Inch NPS: 450-psig operating pressure, 300 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained PTFE seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

E. Service Valves: 500-psig pressure rating, forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, with solder-end connections.

F. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.

G. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.

H. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.6 REFRIGERANT PIPING SPECIALTIES

A. Straight- or Angle-Type Strainers: 430-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen, and screwed cleanout plug, with solder-end connections.

B. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.

C. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

D. Flexible Connectors: 500-psig operating pressure; seamless tin-bronze or stainless-steel core, high-tensile bronze-braid covering, solder-end connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inches long.

2.7 REFRIGERANT

A. ASHRAE 34, R-410A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Aboveground, within Building: Type L drawn-copper tubing.

B. Belowground for 2-Inch NPS and Smaller: Type L annealed-copper tubing.

C. Belowground for Larger than 2-Inch NPS: Type K annealed-copper tubing.

3.3 INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.

D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Belowground, install copper tubing in conduit. Vent conduit outdoors.

G. Insulate suction lines and liquid lines, but insulate them together if adjacent.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.

I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

J. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
3. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
4. Liquid lines may be installed level.

K. Use fittings for changes in direction and branch connections.

L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.

N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS.

O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.

P. Install flexible connectors at the inlet and discharge connection, at right angles to axial movement of compressor, parallel to crankshaft.

Q. Install replaceable-core filter-dryers, with isolation valves and valved bypass.

R. Install refrigerant valves according to manufacturer's written instructions.

S. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.

T. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

U. Mount thermostatic expansion valves in any position, close to evaporator.

1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

V. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.

W. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.

X. Charge system as follows:

1. Install filter-dryer core after leak test, but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. Maintain vacuum for a minimum of 5 hours.
4. Break vacuum with refrigerant gas and charge to 2 psig.

3.4 HANGERS AND SUPPORTS

A. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

B. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

C. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.

D. Spring hangers to support vertical runs.

E. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.

1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

F. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Basic pipe and tube joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.6 VALVE INSTALLATIONS

A. Install refrigerant valves according to manufacturer's written instructions.

B. Install valves on suction and discharge of compressor, for gage taps at compressor inlet and outlet, for gage taps at hot-gas bypass regulators, on inlet and outlet, and on each side of strainers.

C. Install check valves on compressor discharge and on condenser liquid lines on multiple condenser systems.

D. Install refrigerant-charging (packed-angle) valve in liquid line between receiver shutoff valve and expansion valve.

E. Install globe valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

F. Install a full-sized, 3-valve bypass around each dryer.

G. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
   1. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

H. Mount thermostatic expansion valves in any position, close to evaporator.

   1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
   2. Install valve so diaphragm case is warmer than bulb.
   3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
   4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

I. Install pressure-regulating and relief valves as required by ASHRAE 15.

3.7 SPECIALTIES APPLICATION AND INSTALLATION

A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.

B. Install strainers immediately upstream of each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

C. Install strainers on main liquid line where multiple expansion valves with integral strainers are used.

D. Install strainers in suction line of steel pipe.

E. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

F. Install pressure relief valves on ASME receivers, and pipe to outdoors.

G. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.

H. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

I. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

J. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.

K. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.8 CONNECTIONS

A. Electrical: Conform to applicable requirements of Division 16 Sections for electrical connections.

3.9 FIELD QUALITY CONTROL

A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.

1. Pressure test with nitrogen to 200 psig. Perform final tests at 27-psig vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.

B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

C. Repair leaks using new materials; retest.

3.10 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.11 CLEANING

A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.12 COMMISSIONING

A. Charge system using the following procedures:

1. Install core in filter dryer after leak test, but before evacuation.
2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 232300

SECTION 233113 - METAL DUCTWORK

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.

B. Requirements of the following Division 15 Sections apply to this section:

1. "Basic Mechanical Requirements."
2. "Basic Mechanical Materials and Methods."

1.2 SUMMARY

A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

1.3 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Sealing Materials.
2. Fire-Stopping Materials.

C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire-rated and other partitions.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

D. Coordination drawings for ductwork installation in accordance with Division 15 Section "Basic Mechanical Requirements." In addition to the requirements specified in "Basic Mechanical Requirements" show the following:

1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

G. Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

C. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

D. Field-Constructed Mock-Up: Prior to installation of duct systems erect mock-ups representing duct systems pressure classifications greater than 2 inches. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mock-ups on the site. Mock-up may be a representative section of the actual duct system.
2. Include the minimum number of each of the following features and fittings:

a. Five transverse joints.
b. One access door.
c. Two typical branch connections each with at least one elbow.
d. Two typical flexible duct or flexible connector connections for each type duct and apparatus.

3. Perform tests specified in "Field Quality Control." Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.
4. Obtain approval of mock-ups before beginning final fabrication.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALING MATERIALS

A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

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B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.

C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
2. "Pensil 851"; General Electric Co.
3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
5. "RTV 7403"; General Electric Co.
6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Fabricate kitchen hood exhaust ducts with 16-gage, carbon steel sheets for concealed ducts and 18-gage stainless steels for exposed ducts. Weld and flange seams and joints. Conform to NFPA Standard 96.

C. Fabricate dishwasher hood exhaust ducts with 18-gage stainless steels. Weld and flange seams and joints.

D. Acid-Resistant Ducts: Provide factory-fabricated ducts and fittings only; no shop or field fabrication will be allowed. Refer to PVC-Coated Galvanized Steel Sheets in this Section for materials.

E. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

1. Supply Ducts: 3 inches water gage.
2. Return Ducts: 2 inches water gage, negative pressure.
3. Exhaust Ducts: 2 inches water gage, negative pressure.

F. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

2.6 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.7 ROUND AND FLAT OVAL DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

2.8 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.

   a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
   b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:

      1) 3 to 26 inches: 24 gage.
      2) 27 to 36 inches: 22 gage.
      3) 37 to 50 inches: 20 gage.
      4) 52 to 60 inches: 18 gage.
      5) 62 to 84 inches: 16 gage.

   c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:

      1) 3 to 14 inches: 24 gage.
      2) 15 to 26 inches: 22 gage.
      3) 27 to 50 inches: 20 gage.
      4) 52 to 60 inches: 18 gage.
      5) 62 to 84 inches: 16 gage.

   d. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
   e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.

5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.
6. Round Gored Elbows Gages: Same as for nonelbow fittings specified above.
7. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

B. Install ducts with the fewest possible joints.

C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

H. Install insulated ducts with 1-inch clearance outside of insulation.

I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 KITCHEN HOOD EXHAUST DUCT INSTALLATIONS

A. Provide for thermal expansion of ductwork through 2,000-deg F temperature range.

B. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at 50-foot intervals. Locate on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies.

3.3 DISHWASHER EXHAUST DUCT INSTALLATIONS

A. Install dishwasher exhaust duct systems in accordance with SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 2-21.

3.4 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

B. Pressure Classifications Greater Than 3 Inches Water Gage: All transverse joints, longitudinal seams, and duct penetrations.

C. Pressure Classification 2 and 3 Inches Water Gage: All transverse joints and longitudinal seams.

1. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.

D. Seal externally insulated ducts prior to insulation installation.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install concrete insert prior to placing concrete.

F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.6 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories."

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.

D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.7 FIELD QUALITY CONTROL

A. The Owner will contract with an independent testing agency to perform, record, and report leakage tests.

B. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.8 ADJUSTING AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 15 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.

B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 233713 - AIR OUTLETS AND INLETS

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 work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.
3. Louvers.

C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.

1. Diffuser Faces:

    a. Round (RD): Round housing, core of concentric rings, round duct connection.
    b. Square (SQ): Square housing, core of square concentric louvers, square or round duct connection.
    c. Rectangular (RCT): Rectangular housing, core of rectangular concentric louvers, square or round duct connection.
    d. Perforated (PR): Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
    e. Linear (LR): Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

    a. Flush (FL): Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
    b. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

3. Diffuser Patterns:

    a. Fixed (FX): Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.
    b. 1 Way (1-W): Fixed louver face for 1-direction air flow, direction indicated on drawings.
    c. 2 Way (2-W): Fixed louver face for 2-direction air flow, directions indicated on drawings.
    d. 3 Way (3-W): Fixed louver face for 3-direction air flow, directions indicated on drawings.
    e. 4 Way (4-W): Fixed louver face for 4-direction air flow, directions indicated on drawings.

4. Diffuser Dampers:

    a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of diffuser.
    b. Butterfly (BTFY): Two semicircular flaps connected to linkage adjustable from face of diffuser with key, and with straightening grid.

5. Diffuser Accessories:

    a. Plaster Ring (P-R): Perimeter ring designed to act as a plaster stop and diffuser anchor.
    b. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at diffuser take-off.

6. Diffuser Finishes:

    a. White Enamel (W-E): Semi-gloss white enamel prime finish.
    b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:

1. Anemostat Products Div.; Dymanics Corp. of America.
2. Cranes Co.; Div. of Wehr Corp.
3. Krueger Mfg. Co.
4. Titus Products Div.; Philips Industries, Inc.
5. Tuttle & Bailey; Div. of Interpace Corp.

2.2 WALL REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Griller Materials:

   a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

   a. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.
   b. Vertically Straight Blades (V-S): Vertical blades, individually adjustable, at manufacturer's standard spacing.
   c. Horizontal 45 Degree Fixed Blades (H-45 Degrees): Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.

3. Register and Grille Patterns:

   a. Single Deflection (S-D): 1-set of blades in face.
   b. Double Deflection (D-D): 2-sets of blades in face, rear set at 90 degrees to face set.

4. Register and Grille Dampers:

   a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.

5. Register and Grille Accessories:

   a. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at register or grille take-off.

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b. Plaster Frame (P-F): Perimeter frame designed to act as plaster stop and register or grille anchor.
c. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustable.

6. Register and Grille Finishes:

a. White Enamel (W-E): Semi-gloss white enamel prime finish.
b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to, the following:

1. Anemostat Products Div.; Dynamics Corp. of America.
2. Carnes Co.; Div. of Wehr Corp.
3. Titus Products Div.; Philips Industries, Inc.

2.3 LOUVERS:

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers which may be incorporated in the work include, but are not limited to, the following:

1. Airline Products Co.
2. Airolite Co.
3. American Warming & Ventilating Inc.
4. Arrow United Industries, Inc.
5. Construction Specialties, Inc.
6. Dowco Corp.
7. Industrial Louvers, Inc.
8. Louvers & Dampers, Inc.
9. Penn Ventilator Co., Inc.
10. Ruskin Mfg. Co.

11. Safe-Air Inc.
12. Snyder (E.G.) Co., Inc.
13. Vent Products Co., Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS:

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting and may be connected to ducts.

1.2 DEFINITIONS

A. Evaporator-Fan Unit: The part of the split-system air-conditioning unit that contains a coil for cooling (heat rejection for heating operation in heat pump units) and a fan to circulate air to conditioned space.

B. Compressor-Condenser Unit: The part of the split-system air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant (evaporator for heating operation in heat pump units).

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and maintenance data.

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.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set.

2. Filters: One set.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following Manufacturers:

1. Carrier Air Conditioning; Div. of Carrier Corp.
2. Lennox Industries Inc.
3. Mitsubishi Electronics America, Inc.; HVAC Division.
4. Mitsubishi Heavy Industries America, Inc.; Air-Conditioning & Refrigeration Division, Inc.
5. Samsung
6. Sanyo HVAC.
7. Trane Co. (The); Unitary Products Group.
8. Daikin

B. The split system shall have an EER equal to or greater than 16.0.

2.2 EVAPORATOR-FAN UNIT

A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Galvanized steel, with connection for drain; insulated.

B. Floor-Mounting, Unit Cabinet: Enameled steel with removable panels on front and ends.

1. Discharge Grille: Steel with surface-mounted frame or Welded steel bars forming a linear grille and welded into supporting panel.
2. Insulation: Faced, glass-fiber, duct liner.
3. Drain Pans: Galvanized steel, with connection for drain; insulated.Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Heating Coil: Copper-tube water coil, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; and having a 2-position control valve.

D. Heating Coil: Helical, nickel-chrome, electric-resistance heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

E. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

F. Fan Motor: Multispeed, PSC type.

G. Disposable Filters: 1 inch (25 mm) thick, Permanent, cleanable.

H. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed reciprocating type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

B. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

C. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

D. Anchor units to supports with removable, cadmium-plated fasteners.

E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm).

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

B. Install piping adjacent to the unit to allow service and maintenance.

C. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

3.3 FIELD QUALITY CONTROL

A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace them with new components, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238126

Popular, Inc.
Villalba (De Novo) Ground Up Branch
Villalba, Puerto Rico

SECTION 238223 - UNIT VENTILATORS

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 unit ventilators with the followingcooling elements:

1. Chilled-water cooling coil.
2. Refrigerant cooling coil.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

D. Samples of cabinet finish colors for approval.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of unit ventilators.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing unit ventilators similar to those indicated for this Project and that have a record of successful in-service performance.

B. Comply with ARI 440 for testing and rating units.

C. Comply with ASHRAE 33 for testing steam and hydronic coils.

D. Comply with NFPA 70 for components and installation.

E. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Unit Ventilator Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. ABB Aerovent Inc.
2. York
3. Carrier
4. The Trane Co.

2.2 MATERIALS

A. Cabinet: Galvanized steel with removable panels on front and ends.

B. Coil Section Insulation: Faced, heavy-density, glass-fiber insulation over entire section.

C. Adjustable discharge vanes located beneath discharge grilles.

D. Removable inlet grilles.

E. Drain Pans: Galvanized steel, with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.

F. Plastic Laminate Top Surface: Color and pattern as selected by Architect.

G. Cabinet Finish: Metal surfaces filled, coated with baked-on primer, and finished with manufacturer's standard baked enamel; color as selected by Architect.

2.3 COMPONENTS

A. Unitary Refrigeration Chassis: Condensing unit with suction line accumulator, antislugging devices, crankcase heater, filter, drier, winding thermal protection, overcurrent protection, pressure-limiting valve, and operating controls.

1. Refrigeration Coils: 2-row copper tubes with aluminum fins, conforming to ARI 210. Include thermal expansion valve.
2. Exterior Louver: Extruded aluminum sized to refrigeration unit capacity by manufacturer.

B. Hydronic Cooling Coils: Fin-and-tube coil fabricated of copper, with copper or aluminum fins spaced no closer than 0.1 inch, rated 200 psig. Leak test to 300 psig underwater.

C. Fan and Motor: Centrifugal blower, direct driven by a single phase, 2-speed, electric motor with inherent overload protection and resilient motor/fan mount.

D. Wiring Terminations: Match conductor materials and sizes indicated.

E. Filter: Manufacturer's standard throwaway filter, 1 inch thick, on inlet of each fan.

F. Automatic Temperature Controls: Refer to Division 15 Sections.

G. Safety Devices: Each unit has the following safety devices:

1. Manual disconnect switch completely deenergizes unit.
2. Spring-loaded interlock switch deenergizes control circuit and deenergizes fan and heating elements when front panel is removed.
3. Heat-dissipation switch keeps fans running when unit discharge temperature rises above 100 deg F.
4. Overcurrent protection fuses.
5. Branch circuit fusing to protect heating-element subdivision circuits (maximum 48 A).
6. Motor and control circuit fuses.
7. Low-temperature, cut-out thermostat strapped to air coil prevents coil from freezing and liquid from slugging.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and supports to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance of unit ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install unit ventilators as indicated, to comply with manufacturer's written instructions and NFPA 90A.

B. Connect unit ventilators and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

C. Connect fan-coil unit ventilators to hydronic piping according to Division 15 Section "Hydronic Piping." Provide shutoff valve and union or flange at each connection.

3.3 FIELD QUALITY CONTROL

A. Testing: After installing unit ventilators and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Remove and replace malfunctioning units with new units, and retest.

3.4 CLEANING

A. Replace filters in each unit ventilator.

3.5 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to provide startup service.

B. Operate fan motor to verify proper rotation.

C. Operate electric heating elements through each stage to verify proper operation and electrical connections.

D. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 238223

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceways and cables.
2. Sleeve seals.
3. Grout.
4. Common electrical installation requirements.

1.2 SUBMITTALS

A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

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.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

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1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 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 and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

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

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

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. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.

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3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper stranded.

B. Branch Circuits: Copper stranded.

3.2 CONDUCTOR INSULATION

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

G. Class 1 Control Circuits: Type THHN-THWN, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. 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.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

D. Cut sleeves to length for mounting flush with both wall surfaces.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

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F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test all for compliance with requirements.

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2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
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 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

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

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

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B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel in diameter.

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 copper conductor AWG size as shown. Bury at least 24 inches (600 mm) below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. 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 EQUIPMENT GROUNDING

A. 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.

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6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

B. 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.

C. 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.

D. 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.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: 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.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. 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.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

B. Excessive Ground Resistance: If resistance to ground exceeds 10 ohms, 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 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. 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:

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2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. ERICO International Corporation.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut; Tyco International, Ltd.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

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4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by] NFPA 70. Minimum rod size shall be 3/8 inch (10 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 using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. 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.

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 (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

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4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Spring-tension clamps.
6. To Light Steel: Sheet metal screws.
7. 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.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. See Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

1.2 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. EMT: ANSI C80.3.

C. FMC: Zinc-coated steel.

D. LFMC: Flexible steel conduit with PVC jacket.

E. 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.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

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2. Fittings for EMT: Steel or die-cast compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

A. ENT: NEMA TC 13.

B. RNC: NEMA TC 2, Type EPC-40-PVC**,** unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

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. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

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. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.

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C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.

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. Thomas & Betts Corporation.
    b. Walker Systems, Inc.; Wiremold Company (The).
    c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

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. Butler Manufacturing Company; Walker Division.
    b. Enduro Systems, Inc.; Composite Products Division.
    c. Hubbell Incorporated; Wiring Device-Kellems Division.
    d. Lamson & Sessions; Carlon Electrical Products.
    e. Panduit Corp.
    f. Walker Systems, Inc.; Wiremold Company (The).
    g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

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E. Nonmetallic Floor Boxes: Nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. 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.
2. Nonmetallic Enclosures: Plastic.

I. 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: RNC**,** Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
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 as shown on drawings.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
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.

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6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable: EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic 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 and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

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 (150 mm) 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 RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

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K. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed 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 or LFNC in damp or wet locations not subject to severe physical damage.

N. 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.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

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4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.
3. Manholes.

1.2 SUBMITTALS

A. Product Data: For accessories for manholes, handholes, and boxes.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder or Step details, when required.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

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. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

C. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

D. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.

a. Color: Red dye added to concrete during batching.

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b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.3 HANDHOLES AND BOXES

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering. As indicated for each service.
6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

B. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

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. Armorcast Products Company.
   b. Carson Industries LLC.
   c. Christy Concrete Products.
   d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of fiberglass.

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. Carson Industries LLC.
   b. Christy Concrete Products.
   c. Nordic Fiberglass, Inc.

2.4 PRECAST MANHOLES

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. Ornamental Poles.

C. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

D. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

E. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 UTILITY STRUCTURE ACCESSORIES

A. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, as per respective utility's standard.

a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.

a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
c. Legend: "SIGNAL" for communications, data, and telephone duct systems.

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B. Manhole Sump: Depression cast in floor.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

D. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

E. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

F. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

G. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

H. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.2 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not

use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and
   complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.3 INSTALLATION OF CONCRETE MANHOLES

A. Comply with ASTM C 891, unless otherwise indicated.

B. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

C. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

D. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.

E. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.

F. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches (98 mm) for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.4 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

1.1 SUMMARY

A. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 COORDINATION

A. Tests and Inspections:

1. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and provide notice at least seven days in advance.
2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design seismic control system in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."

1.4 COMPONENTS

A. Seismic-Restraint Devices:

1. Restraint Channel Bracings: MFMA-4, shop- or field-fabricated bracing assemblies.
2. Restraint Cables: ASTM A603 galvanized-steel cables.
3. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
4. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
5. Anchor Bolts: Mechanical type, seismic rated.

END OF SECTION 260548.16

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

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C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

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1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION 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. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Material, color & wording as per utility's standard.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

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1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

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B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 18 inches overall.

G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

END OF SECTION 260553

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to USB-97.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUBMITTALS

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

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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

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1.4 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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

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.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen Wash-Down Areas or outdoor in areas less than 1 mile from sea shore: NEMA 250, Type 4X, stainless steel or non-metallic.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top or bottom, contractor to coodinate.

D. Phase, Neutral, and Ground Buses: Tin-plated aluminum.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Mechanical type.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

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B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Mains: Circuit breaker or lugs only, as shown on plans.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

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.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

5. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
6. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
7. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

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8. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
9. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
10. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
11. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
12. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Mount top of trim 90 inches (2286 mm) 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.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

G. Comply with NECA 1.

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3.2 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 and incorporating Owner's final room designations. Obtain approval before installing. 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."

3.3 FIELD QUALITY CONTROL

A. 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.

B. Panelboards will be considered defective if they do not pass tests and inspections.

C. 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.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall-box motion sensors.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).

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2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 5351 (single), 5352 (duplex).
    b. Hubbell; HBL5351 (single), CR5352 (duplex).
    c. Leviton; 5891 (single), 5352 (duplex).
    d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; GF20.
    b. Pass & Seymour; 2084.
    c. Hubbell

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
    a. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    b. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    c. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

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C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221PL for 120 V and 277 V.
    b. Hubbell; HPL1221PL for 120 V and 277 V.
    c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
    d. Pass & Seymour; PS20AC1-PLR for 120 V.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221L.
    b. Hubbell; HBL1221L.
    c. Leviton; 1221-2L.
    d. Pass & Seymour; PS20AC1-L.

3. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 1995.
    b. Hubbell; HBL1557.
    c. Leviton; 1257.
    d. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 1995L.
    b. Hubbell; HBL1557L.
    c. Leviton; 1257L.
    d. Pass & Seymour; 1251L.

2.5 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF."

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 6111 for 120 V, 6117 for 277 V.
b. Hubbell; WS1277.
c. Leviton; ODS 10-ID.
d. Pass & Seymour; WS3000.
e. Lutron Systems.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; AT120 for 120 V, AT277 for 277 V.
b. Leviton; ODS 15-ID.

3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Long-Range Wall-Switch Sensors:

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1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATD1600WRP.
    b. Leviton; ODW12-MRW.
    c. Watt Stopper (The); DT-200.

3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

D. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATP120HBRP.
    b. Leviton; ODWHB-IRW.
    c. Pass & Seymour; HS1001.
    d. Watt Stopper (The); CX-100-3.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

2.7 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 3560-6.
    b. Leviton; 40649.

3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 3562.
    b. Leviton; 40595.

3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

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2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.10 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Color to be selected by architects, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. 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 the boxes.

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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 just before they are spliced or terminated on devices.
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 meet provisions of 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 all devices that have been in temporary use during construction or that show signs that they 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 (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the 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. 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.

F. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

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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.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with red filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience 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 not acceptable.
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. The 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, and retest as specified above.

END OF SECTION 262726

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SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.

B. See Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.2 SUBMITTALS

A. Product Data: For each type of packaged engine generator and accessory indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and maintenance data.

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G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, in PR Metro Area, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110 requirements for Level [**1**] [**2**] emergency power supply system.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.4 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Caterpillar; Engine Div.
2. Generac Power Systems, Inc.
3. Kato Light.
4. Kohler, Inc.
5. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 65 dBA or less w/sound attenuated enclosure.

J. Air-Intake Filter: Heavy duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

a. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.
2. Capacity: Fuel for 72 hours' continuous operation at 75 percent rated power output.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Outdoor type aluminum sound attenuated – 65 db @ 7.0 meters where specified on drawings.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set before shipping form factory.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
2. Report factory test results within 10 days of completion of test.
3. Do not ship unit unless it is 100% compliance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

G. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

H. Connect engine exhaust pipe to engine with flexible connector.

I. Connect fuel piping to engines with a gate valve and union and flexible connector.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and retest as specified above.

H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

B. Provide a four-hour on-site training to system operators.

END OF SECTION

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes automatic transfer switches rated 600 V and less.

B. See Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.

C. See Division 21 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned 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.

D. Field quality-control test reports.

E. Operation and maintenance data.

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1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. AC Data Systems, Inc.
b. Caterpillar; Engine Div.
c. Emerson; ASCO Power Technologies, LP.
d. GE Zenith Controls.
e. Kohler Power Systems; Generator Division.
f. Onan/Cummins Power Generation; Industrial Business Group.
g. Russelectric, Inc.

2. Transfer Switches Using Molded-Case Switches or Circuit Breakers:

a. AC Data Systems, Inc.
b. Eaton Electrical Inc.; Cutler-Hammer.
c. GE Zenith Controls.
d. Hubbell Industrial Controls, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

H. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

I. Battery Charger: For generator starting batteries.

1. Float type rated 10 A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

J. Enclosures: General-purpose NEMA 250, Type [**1**] [**3R**] [**12**], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.

F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated.

G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Identify components according to Division 26 Section "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 265100 - INTERIOR LIGHTING

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. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section “Central Dimming Control” for architectural dimming systems.
3. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
4. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

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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. Ballast, including BF.
4. Energy-efficiency data.

B. Installation instructions.

C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

G. Warranty: Sample of special warranty.

1.5 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.6 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.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

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B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

G. 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.

H. Diffusers 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.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

2.2 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.

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3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A Ballast.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

B. luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

2.3 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.

2.4 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.

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1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Housing: NEMA 250, Type 1 enclosure.
5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 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. General Requirements for Emergency Lighting Units: 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.

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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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. 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.

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3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 265100

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SECTION 265600 - EXTERIOR LIGHTING

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 luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.
4. Luminaire lowering devices.

B. Related Sections:

1. Division 26 Section "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. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

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.

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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.
    a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.

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. Wiring Diagrams: For power, signal, and control wiring.

1.5 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. 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 IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.6 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 above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.

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PART 2 - PRODUCTS

2.1 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.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

E. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

H. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

I. 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.

J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

K. 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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L. 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.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

2.2 FLUORESCENT BALLASTS AND LAMPS

A. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: Class A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

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1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

3.2 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.

1. Verify operation of photoelectric controls.

C. 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 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Firefighters' two-way telephone communication service.
8. Magnetic door holders.
9. Remote annunciator.
10. Addressable interface device.
11. Digital alarm communicator transmitter.
12. Radio alarm transmitter.
13. System printer.

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.

B. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. 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.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control reports.

H. 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.

I. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. 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.

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 Certification: Obtain certification according to NFPA 72 by an NRTL.

F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.

H. NFPA Certification: Obtain certification according to NFPA 72 by qualified certification agency.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

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1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fire Control Instruments, Inc.; a Honeywell company.
2. Fire Lite Alarms; a Honeywell company.
3. GE Infrastructure; a unit of General Electric Company.
4. Gentex Corporation.
5. Harrington Signal, Inc.
6. NOTIFIER; a Honeywell company.
7. Siemens Building Technologies, Inc.; Fire Safety Division.
8. Silent Knight; a Honeywell company.
9. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.
9. Fire-extinguishing system operation.
10. Fire standpipe system.

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. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.

9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Activate emergency shutoffs for gas and fuel supplies.
11. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

D. 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.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

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.

1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 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 A.

   a. Initiating Device Circuits: Style E.
   b. Notification Appliance Circuits: Style Z.
   c. Signaling Line Circuits: Style 2.
   d. Install no more than 50 > addressable devices on each signaling line circuit.

2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

   a. Initiating Device Circuits: Style C.
   b. Notification Appliance Circuits: Style Y.
   c. Signaling Line Circuits: Style 4.5.
   d. Install no more than **50** addressable devices on each signaling line circuit.

D. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.

1. Pressurization starts when any alarm is received at fire-alarm control unit.
2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. 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.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and

sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

    a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium or Sealed, valve-regulated, recombinant lead acid.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe

appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 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 four-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.
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:

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. Ionization Smoke Detector:

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.).

D. 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.

2.6 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. Mounting: Adapter plate for outlet box mounting .
2. 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. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 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. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. 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.

F. 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. 15/30/75/110 cd, selectable in the field as per NFPA 72 requirements.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

G. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting surface mounted and bidirectional.

5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 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.

2.10 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 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:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

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 concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use 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.

C. 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."

D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. 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.
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.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

H. 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.

I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

J. 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.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

N. Annunciator: Install with top of panel not more than 72 inches (1830 mm) 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 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated air-conditioning duct systems.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.
10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
11. Supervisory connections at fire-pump engine control panel.

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.

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 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