City of Hallandale Beach
Fire Rescue Station / EOC # 7
Project No. 140403

Technical Specifications

EXHIBIT "A"

August 2015

CURRIE
SOWARDS
AGUILA
ARCHITECTS

Hallandale Beach
PROGRESS. INNOVATION. OPPORTUNITY.

HALLANDALE BEACH FIRE RESCUE STATION & EOC #7
Hallandale Beach, Florida
Project No. 140403

Architect:
Currie Sowards Aguila Architects
185 NE 4th Avenue, Suite 101
Delray Beach, Florida 33483
Phone: 561-276-4951

Structural Engineer:
McCarthy & Associates, Inc.
601 N. Congress Avenue, Unit 106A
Delray Beach, Florida 33445
Phone: 561-265-6864

Mechanical, Electrical & Plumbing Engineer:
Thompson Youngross Engineering Consultants
112 SE 10th Street
Delray Beach, Florida 33483
561-274-0200

Civil Engineer / Landscape Engineer:
301 East Atlantic Blvd.
Pompano Beach, Florida 33060
954-788-3400

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CITY OF HALLANDALE BEACH - FIRE STATION 7
CSA PROJECT NUMBER: 140403
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SECTION 011100 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

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

1.2 PROJECT INFORMATION

A. Project Identification: City of Hallandale Beach Fire Rescue Station 7.

1. Project Location: 111 Foster Road, Hallandale Beach, Florida.

B. Owner: City of Hallandale Beach.

1. Owner's Representative: Sarita Shamah, P.E., Capital Projects Manager.

C. Architect: Currie Sowards Aguila Architects, Delray Beach, Florida. Attention José N. Aguila, AIA, LEED AP

D. Contractor: TBD.

E. This project has registered with the U. S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) Green Building Rating System Program. More information about the requirements and details of the program can be found at the web site: www.usgbc.org .

F. In conjunction with this registration, the Owner has established environmental goals for this project; upon completion this project is to achieve the LEED Program's Certified Certification.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Project consists of construction of a new four-bay fire rescue station that will house up to ten fire fighters. New administration office for the Fire Department and a new combination Emergency Operations Center (EOC) and training facility. Building will be approximately 25,000 square feet and include site work and utilities. Project includes but is not limited to exposed concrete, steel construction, interior finishes, site utilities, landscaping and irrigation.

B. Type of Contract.

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

1.4 ACCESS TO SITE

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

1.5 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by adjacent properties.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to public with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.

D. Nonsmoking Project: Smoking is not permitted within the building or project site.

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

1.6 SPECIFICATION AND DRAWING CONVENTIONS

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

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

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

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

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

1.7 MISCELLANEOUS PROVISIONS

A. This project is pursuing LEED BD&C v2009 New Construction Silver certification. All contractors with scope contributing towards the LEED requirements shall be responsible for documenting and executing all activities as directed by Section 018113 of the specification book – LEED Requirements for further information.

B. An independent commissioning agent has been retained to ensure that this project is completed according to owner requirements. Commissioned systems shall include HVAC, lighting / lighting control, and domestic hot water. All contractors with scope for these systems shall be responsible for carrying out testing activities as directed by commissioning agent. See the Project Commissioning Plan for further information.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A, or Architect’s approved alternate form.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

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

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within Ten (10) working days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within ten (10) working days of receipt of request. Architect’s determination is final.
a. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 30 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.

f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience or poor planning: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination of drawings and specifications.
2. Bid addendums.
3. Requests for Information (RFIs).
4. Project meetings.
5. Approved change orders

1.2 DEFINITIONS

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

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1.5 COORDINATION DRAWINGS

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

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
3. Excessive or frivolous RFIs will result in back charges to Contractor at the firm’s current hourly rates. Frivolous RFIs are those that can be addressed by taking the time to review the plans and specifications.

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

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Any form standard to the industry that is acceptable to Architect.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five working days for Architect's response for each clearly written RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.
    d. Requests for adjustments in the Contract Time or the Contract Sum.
    e. Requests for interpretation of Architect's actions on submittals.
    f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five working days of receipt of the RFI response. Failure to respond within allotted time frame may result in forfeiture of future claim.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

A. General: Contractor will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

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

B. Mandatory Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than thirty days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Sustainable design requirements.
    l. Preparation of record documents.
    m. Use of the premises.
    n. Work restrictions.
    o. Working hours.
    p. Owner's occupancy requirements.
    q. Responsibility for temporary facilities and controls.
    r. Procedures for disruptions and shutdowns.
    s. Construction waste management and recycling.
    t. Parking availability.
    u. Office, work, and storage areas.
    v. Equipment deliveries and priorities.
    w. First aid.
    x. Security.
    y. Progress cleaning.

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

C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Sustainable design requirements.
    i. Review of mockups.
    j. Possible conflicts.
    k. Compatibility problems.
    l. Time schedules.
    m. Weather limitations.
    n. Manufacturer's written instructions.
    o. Warranty requirements.
    p. Compatibility of materials.
    q. Acceptability of substrates.
    r. Temporary facilities and controls.
    s. Space and access limitations.
    t. Regulations of authorities having jurisdiction.
    u. Testing and inspecting requirements.
    v. Installation procedures.
    w. Coordination with other work.
    x. Required performance results.
    y. Protection of adjacent work.
    z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

      1) Review schedule for next period.

   b. Review present and future needs of each entity present, including the following:

      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Status of sustainable design documentation.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Status of correction of deficient items.
      13) Field observations.
      14) Status of RFIs.
      15) Status of proposal requests.
      16) Pending changes.
      17) Status of Change Orders.
      18) Pending claims and disputes.
      19) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for other management requirements.

2. Section 013300 “Submittal Procedures” for coordination of schedules.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

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

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

D. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 INFORMATIONAL SUBMITTALS

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

1. PDF electronic file.

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

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

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit updates with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

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

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion and final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat site work activities separate from shell and from finishes areas as separate numbered activities for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 dayss, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

   a. Structural Steel.
   b. Mechanical Equipment.
   c. Exterior bi-fold doors

3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

2. Work Stages: Indicate important stages of construction for each major portion of the Work.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Recovery Schedule: When periodic update indicates the Work is 30 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.

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

1. Use Microsoft Project, Primavera, Prolog, or other specifically created software for Windows XP operating system.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for commencement of the Work. The first scheduled payment will NOT be processed until a schedule has been submitted, reviewed, and accepted by the Architect and Owner.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.

4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain.
7. Accidents.
8. Meetings and significant decisions.
9. Inspections by any Agency or Authority having jurisdiction.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and/or disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule three days before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post initial schedule and copy of updated schedule in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Pre-Construction site documentation.
   2. Periodic construction photographs.

B. Related Requirements:

   1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.2 INFORMATIONAL SUBMITTALS

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

B. Digital Photographs: Submit unaltered, original, full-size image files within five (5) days of taking photographs.

   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Identification: Provide the following information with each image description in file metadata tag:

      a. Name of Project.
      b. Name and contact information for photographer.
      c. Date photograph was taken.
      d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

C. Pre-Construction Photographic Documentation: Provide digital photographs and legend or key plan with sufficient clarity to allow the City and GC to document all pre-construction conditions of the site up to and including the perimeter center line of all roadways.
   1. Lack of clarity will ALWAYS result in favor of the City.
   2. Submit to City prior to commencing any construction activities.

D. Construction Photographs: Submit three (3) prints of each photographic view within five (5) days of taking photographs.

   1. Format: 8-by-10-inch smooth-surface matte prints on single-weight, commercial-grade photographic paper.
   2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:

a. Name of Project.
b. Name of Architect.
c. Name of Contractor.
d. Date photograph was taken if not date stamped by camera.
e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
f. Unique sequential identifier keyed to accompanying key plan.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.4 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner and Architect for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, with minimum size of 8 megapixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

D. Periodic Construction Photographs: Take a minimum of five (5) photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take a minimum of 15 color exterior photographs and seven (7) interior photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

F. Additional Photographs: Owner may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

    a. Special events planned at Project site.
    b. Immediate follow-up when on-site events result in construction damage or losses.
    c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    d. Substantial Completion of a major phase or component of the Work.
    e. Extra record photographs at time of final acceptance.
    f. Owner's request for special publicity photographs.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

B. Requirements indicated herein apply to each and every other specification section regardless of individual section requirements. When in conflict the most stringent requirement applies.

C. Related Requirements:

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

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect may furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Architect.
c. Contractor may use digital files as their base but takes full responsibility and risk should the base not be accurate for any reason whatsoever.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 working days for review of each resubmittal.

D. Paper Submittals: If paper submittals are used, place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Name of subcontractor.
f. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

g. Number and title of appropriate Specification Section.
h. Drawing number and detail references, as appropriate.

i. Location(s) where product is to be installed, as appropriate.
j. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

   a. Transmittal Form for Paper Submittals: Use industry acceptable form.
   b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect.
      6) Name of Contractor.
      7) Name of firm or entity that prepared submittal.
      8) Names of subcontractor.
      9) Category and type of submittal.
      10) Submittal purpose and description.
      11) Specification Section number and title.
      12) Specification paragraph number or drawing designation and generic name for each of multiple items.
      13) Drawing number and detail references, as appropriate.
      14) Indication of full or partial submittal.
      15) Transmittal number**,** numbered consecutively.
      16) Submittal and transmittal distribution record.
      17) Remarks.
      18) Signature of transmitter.

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

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

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

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Contractor.
    e. Name of firm or entity that prepared submittal.
    f. Names of subcontractor, manufacturer, and supplier.
    g. Category and type of submittal.
    h. Submittal purpose and description.
    i. Specification Section number and title.
    j. Specification paragraph number or drawing designation and generic name for each of multiple items.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.
    m. Related physical samples submitted directly.
    n. Indication of full or partial submittal.
    o. Transmittal number**,** numbered consecutively.
    p. Submittal and transmittal distribution record.
    q. Other necessary identification.
    r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

    a. Project name.
    b. Number and title of appropriate Specification Section.
    c. Manufacturer name.
    d. Product name.
    e. Any other information unique to the submittal.

F. Options: Identify options requiring selection by Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

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

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

1.5 LEED Submittals:

A. LEED Submittals: Comply with requirements specified in Division 1 Section "LEED Requirements."

B. Number of Copies: Submit electronic copy of LEED submittals to project's LEED consultant, The Spinnaker Group, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Submit electronic submittals via email as PDF electronic files.

a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Action Submittals: Submit a minimum of three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
3. Informational Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will not return copies.
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

   a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 12 by 18 inches, but no larger than 24 by 36 inches.
3. Submit Shop Drawings in the following format:

   a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one set of submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit two sets of Samples. Architect will retain one sample set.

        1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Submit product schedule in the following format:

    a. PDF electronic file.

F. Coordination Drawings Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

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

H. Application for Payment and Schedule of Values: Comply with requirements specified in Owner’s Payment Procedures.

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

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

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

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

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

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

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

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

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

R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

S. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."

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

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

V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations.

Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

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

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

1. Reviewed

2. Reviewed As Noted

3. Revise and Resubmit

4. Rejected

5. Submittal not Required Returned Without Action

C. Architect's review action stamp does not relieve the Contractor from any and all requirements for compliance with all requirements of the Contract Documents. Architect's or Engineer's review is solely for the purpose of verifying that the GC or specific trade understands the project requirements.

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

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review, or discarded.

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

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

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

1.2 DEFINITIONS

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

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

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

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

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

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

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

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

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

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

1.3 CONFLICTING REQUIREMENTS

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

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

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

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

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

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

1.6 QUALITY ASSURANCE

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

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

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

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

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

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

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

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

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. When testing is complete, remove test specimens, assemblies, and mockups, do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Owner, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect five days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections <u>not explicitly assigned to Owner</u> are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed, or as determined by testing agency.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

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

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Structural Inspections: Owner will engage a qualified special structural inspector to conduct special inspections and observations required by authorities having jurisdiction as the responsibility of Owner and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.

4. Submitting a final report of special inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Reinspecting corrected work.

B. Coordination: Coordinate scheduling of field inspections by Owner engaged Special Inspector and make every effort to cooperate so that visits are meaningful. Excessive and inefficient visits may result in back charges to Contractor via deductive change order. In other words, be mindful of his costs and don't abuse required site visits.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

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

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

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

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011100 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to Architect, testing agencies, and authorities having jurisdiction.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its

use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Where Owner’s fencing does not cover construction areas, provide minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rail.

2.2 TEMPORARY FACILITIES

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

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

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

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011100 "Summary."

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

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. Connect to Municipal water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install temporary construction electric power service overhead unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.

1. At each telephone, post a list of important telephone numbers.

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

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

J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
2. Memory: 4 gigabyte.
3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
4. Display: 22-inch LCD monitor with 128 Mb dedicated video RAM.
5. Network Connectivity: 10/100BaseT Ethernet.
6. Productivity Software:

a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
b. Adobe Reader 7.0 or higher.
c. WinZip 7.0 or higher.

7. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
8. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
9. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

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

C. Project Signs: Provide Project signs as required by the Architect or Owner. Unauthorized signs are not permitted. Subcontractor’s advertising signs will not be allowed.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

E. Temporary Elevator Use: Use of elevator for construction activities is **not permitted.**

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

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing." Refer to Civil drawings.

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

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

F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

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

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

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

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Discard or replace water-damaged and wet material.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.

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

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

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 – TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Contract Requirements and Division 1 – General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. This work includes the protection and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.

1.3 DEFINITIONS

A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 SUBMITTALS

A. Tree Pruning Schedule: Written schedule from arborist detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

B. Qualification Data: For tree service firm and arborist.

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

1.5 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.

B. Tree Pruning Standard: Comply with ANSI A300 (Part 1), "Tree, Shrub, and Other Woody Plant Maintenance--Standard Practices (Pruning)."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.

B. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

C. Organic Mulch: Shredded hardwood, Ground or shredded bark, Wood and bark chips, free of deleterious materials.

PART 3 - EXECUTION

3.1 PREPARATION

A. Temporary Fencing: Install temporary fencing around tree protection zones to protect remaining trees and vegetation from construction damage. Maintain temporary fence and remove when construction is complete.

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

C. Mulch areas inside tree protection zones and within drip line of trees to remain and other areas indicated.

1. Apply 3-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

D. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems.

E. Maintain tree protection zones free of weeds and trash.

3.2 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.

1. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction.

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

D. Where utility trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.
1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade beyond tree protection zones. Maintain existing grades within tree protection zones.
1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots with sharp pruning instruments; do not break or chop.

B. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.4 TREE PRUNING

A. Prune trees to remain that are affected by temporary and permanent construction.

B. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.

C. Pruning Standards: Prune trees according to ANSI A300 (Part 1).

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

E. Chip removed tree branches and dispose of off-site.

3.5 TREE REPAIR AND REPLACEMENT

A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

B. Remove and replace trees indicated to remain that die or are damaged during construction operations that City of Miramar inspector determines are incapable of restoring to normal growth pattern.
1. Provide new trees of same size and species as those being replaced; plant and maintain as specified.

C. Aerate surface soil, compacted during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable

product request within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

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

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

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

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

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 INFORMATIONAL SUBMITTALS

A. Certified Surveys: Prior to pouring foundation, submit five copies signed by land surveyor confirming execution of location and elevation as required by the Contract Documents.

B. Final Property Survey: Submit five copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

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

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, 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; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where

indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. 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 that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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

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

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

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.

6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

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

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

3.4 FIELD ENGINEERING

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

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

B. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

C. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

3.5 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

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

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

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

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

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

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

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

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

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

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

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

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

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

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

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

3.9 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.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous construction waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Divert: To use material for any purpose other than disposal in a landfill.

E. Diversion Requirement: Percentage of the total construction and demolition debris generated by a project that is required to be diverted from a landfill as required for this project.

F. LEED: Leadership in Energy and Environmental Design Rating System as established by U.S. Green Building Council.

G. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

H. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

I. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE GOALS

A. Salvage/Recycle Goals: Owner's goal is to salvage and recycle as much nonhazardous construction waste as possible.

B. Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Construction Waste:
   a. Site-clearing waste.
   b. Masonry and CMU.
   c. Lumber.
   d. Wood sheet materials.
   e. Wood trim.
   f. Metals.
   g. Piping.
   h. Electrical conduit.
   i. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include separate reports for salvage, demolition and construction waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. LEED Submittal: LEED letter template for Credit MR 2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Refer to Schedule at the end of this section.

H. Qualification Data: For Waste Management Coordinator.

I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.

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

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

E. Forms: Prepare waste management plan on forms included at end of Part 3.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Contractor shall submit Waste Reduction Progress Reports concurrent with each Application for Payment, in accordance with paragraph "Submittals." Prepare LEED letter template for Credit MR 2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. At completion of project Contractor shall also submit Waste Reduction Calculations, Records of Donations, Recycling and Processing Facility Records, and Landfill and Incinerator Disposal Records in accordance with paragraph entitled "Submittals."

C. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

F. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

D. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

E. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

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

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

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

   a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

a. Comply with requirements in Division 32 Section "Plants." for use of clean ground gypsum board as inorganic soil amendment.

3.4 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
3. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

D. Final surveys.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of seven days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by the Owner. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner’s signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request. All items may not apply until final.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Complete final cleaning requirements, including touchup painting.

9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 7 days prior to date the work will be completed and ready for final inspection and tests. Attach copy of Contractor’s punch list items open for completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Owner Project Requirememnts.
2. List of Incomplete Items: Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order. Provide separate list for exterior and interior spaces.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:

    a. MS Excel electronic file. Architect will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper. Do not use three-ring binders that are wider than three inches.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

D. Quantity: Provide two full copies of all binders with equal contents and organization. Deliver to the Owner via the Architect unless otherwise instructed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Clean areas adjacent to construction site that in any way that may have been impacted by construction activities.
c. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
d. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
e. Remove tools, construction equipment, machinery, and surplus material from Project site.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent or required by law.
l. Wipe surfaces of mechanical and electrical equipment, and elevator equipment, and other similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls" Article 3.4 H. Prepare written report.

3.2 REPAIR OF THE WORK

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

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
1. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:
1) Submit PDF electronic files of scanned record prints and two set(s) of prints.
2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy of Project's Specifications as well as one pdf electronic file copy, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

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

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

b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file **with comment function enabled**.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information, with appropriate executed releases.

C. 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. 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. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purpose. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

REPORT OF
GEOTECHNICAL EXPLORATION

CITY OF HALLANDALE BEACH – MAIN FIRE STATION
BETWEEN NW 5TH ST. & NW 4TH ST AND
NW 1ST AVE. & NW 2ND AVE.
HALLANDALE BEACH, FLORIDA 33009

FOR

CITY OF HALLANDALE BEACH
400 SOUTH FEDERAL HIGHWAY
HALLANDALE BEACH, FLORIDA 33009

PREPARED BY

NUTTING ENGINEERS OF FLORIDA, INC.
2051 NW 112TH AVE
SUITE NO. 126
MIAMI, FLORIDA 33172

PROJECT NO.: 213.13

JULY 2014

Nutting Engineers
of Florida Inc. | Established 1967
Your Project is Our Commitment

Geotechnical & Construction Materials
Engineering, Testing & Inspection
Environmental Services

Offices throughout the state of Florida

www.nuttingengineers.com info@nuttingengineers.com

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of Florida Inc. | Established 1967
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2051 N.W. 112th Avenue, Suite 126
Miami, Florida 33172
305-557-3083
Toll Free: 877-NUTTING (688-8464)
Fax: 305-824-8827
Broward 954-941-8700
Palm Beach 561-736-4900
St. Lucie 772-408-1050
www.nuttingengineers.com

Geotechnical and Construction Materials | Engineering, Testing and Inspections | Environmental Services

July 30, 2014

Ms. Sarita Shamah, P.E.
City of Hallandale Beach
400 South Federal Highway
Hallandale Beach, Florida 33009
Phone: (954) 457-2995
Fax: (954) 457-1454
Email: sshamah@hallandalebeachfl.gov

Subject: Report of Geotechnical Exploration
City of Hallandale Beach – Main Fire Station
Between NW 5th St. & NW 4th St and NW 1st Ave. & NW 2nd Ave.
Hallandale Beach, Florida 33009

Dear Ms. Shamah,

Nutting Engineers of Florida, Inc. performed a geotechnical exploration for the proposed Main Fire Station at the above referenced site. The purpose of this exploration was to obtain information concerning the site and subsurface conditions at a specific location in order to provide site preparation and foundation design recommendations for support of the proposed construction. This report presents our findings and recommendations.

PROJECT INFORMATION

Per your electronic transmission dated July 19, 2014, and review of the aerial provided, it is our understanding that plans for this project call for the construction of a new fire station and emergency operation center at the above referenced site. The construction is proposed to have a footprint of approximately 20,000 square feet, and possibly have three stories.

We note that if any of our understandings or assumptions are incorrect, we should be notified so that we can re-evaluate our analysis and may amend our recommendations accordingly.

OFFICES
Palm Beach
Miami-Dade
St. Lucie

GENERAL SUBSURFACE SOIL CONDITIONS

Subsurface Soil Exploration

The exploration of subsurface conditions included site observation, review of the Broward County Soil Survey Map and Standard Penetration Test borings (ASTM D-1586) performed

Nutting Engineers of Florida, Inc. has performed a total of three (3) Standard Penetration Test borings (ASTM D-1586) to depths of 30 feet below the existing ground surface in order to evaluate the subsurface soil conditions. Furthermore, three (3) 'Usual Open-Hole' exfiltration tests were performed in accordance with South Florida Water Management District (SFWMD) specifications to depths of six feet below the existing ground surface.

The locations of the tests are indicated on the attached Boring Location Plan. Individual test boring reports are presented in the Appendix of this report. The test locations were established in the field using approximate methods; namely, a measuring wheel and available surface controls.

Soil Survey Maps Review

A review of the United States Soil Conservation map of Broward County indicates that at the time the survey was conducted, Duette-Urban land complex and Urban Land series were located in the area of the site. These are both described as occurring in areas where the natural soil is mostly covered by pavement or buildings and cannot be readily observed. Fifty to seventy percent of the complex consists of Duette soils that are nearly level, moderately well drained soils on low ridges and knolls in the eastern part of the survey area. The Urban Land series consists of soils in the Hallandale, Margate, Immokalee and Basinger series that have been altered by fill spread on the surface to an average thickness of approximately 12 inches. We note that the maximum depth of the survey is six feet.

Test Boring Results

The appended test boring logs present information and descriptions of the subsurface conditions at each specific test boring location. In general, test boring logs indicate a surface layer of very loose to loose quartz fine sand to depths of approximately eight to seventeen feet, underlain by soft to medium hard tan limestone with silty quartz fine sand to an approximate depth of thirty feet below ground surface, the maximum depth explored.

A detailed description of the soil/rock profile is presented in the test boring records provided in the Appendix. The Standard Penetration Test N-values are used to evaluate the relative density of granular soils. The correlation of penetration resistance with relative density is presented in the Soil Classification Criteria attached in the Appendix.

Ground Water

The immediate groundwater level was measured at the boring locations at the time of drilling. The groundwater level was encountered at an approximate depth of five and a half to seven feet below the existing ground surface. The immediate depth to groundwater measurements presented in this report may not provide a reliable indication of stabilized or longer term depth to groundwater at this site.

Water table elevations can vary dramatically with time through rainfall, droughts, storm events, flood control activities, nearby surface water bodies, tidal activity, pumping and many other factors. For these reasons, this immediate depth to water data **should not** be relied upon alone for project design considerations.

Further information regarding stabilized groundwater elevations at the site could be developed upon specific request. Additional evaluation might include monitoring of peizomenters, survey of the project area for evidence of current groundwater elevation influences such as well fields, obvious construction dewatering, tidal activity, flood control canals and other surface water bodies.

Exfiltration Results

Three 'Usual Open-Hole' exfiltration tests were performed in accordance with South Florida Water Management District (SFWMD) specifications to depths of six feet below the existing ground surface. The tests were performed in order to determine the hydraulic conductivity of the in situ subsurface soils to evaluate drainage requirements for the project, by others.

The hydraulic conductivity values ranged from 1.23×10^{-3} to 2.27×10^{-4} cubic feet per second, per square foot, per foot of head. Detailed soil descriptions and flow rates are presented in the Appendix.

ANALYSIS AND RECOMMENDATIONS

As discussed in the above sections, the soil borings revealed very loose conditions within the upper portion of the soil profile. Supporting the proposed structure on the unamended profile may lead to unacceptable total and differential settlements. We recommend performing a program of vibrocompaction within the proposed construction area and subsequently supporting the proposed fire station on shallow foundations once the operations have been completed. The following sections present our recommendations for vibrocompaction and shallow foundations, as well as related site preparation recommendations.

Vibrocompaction

The vibrocompaction process involves inserting a vibratory flot by water jetting and vibration into the soils. The vibration action causes the granular soils to rearrange in a more densified state. The increase in density of the soils causes a loss of volume; and sands or graded stone are used to replace the lost volume. This technique typically improves the soils to provide an allowable bearing capacity of 4,000 to 8,000 pounds per square foot, depending on equipment power, time, and soil type. The following recommendations are for improvement of the soils to provide for an allowable bearing capacity of 5,000 pounds per square foot.

We recommend that a vibro-flot with a minimum of 175 horsepower be used for this project. We recommend that vibrocompaction points be spaced five to six feet on center within column, wall footing and slab areas, and should be penetrated to at least ten feet below the bottom of the proposed footings, or until refusal of the probe is encountered. During the vibrocompaction operations, verification borings should be performed to evaluate the level of improvement, and verify that the allowable bearing capacity has been achieved.

The vibrocompaction contractor should prepare shop drawings, which indicate the location and depth of the points and equipment to be used. This submittal should be reviewed by Nutting Engineers. It is important that the installation of the vibrocompaction points be installed under the full time observation of the Nutting project geotechnical engineer. This is to ensure that the engineering intent is being satisfied.

Upon completion of the vibrocompaction and satisfactory verification test borings, the entire site should be leveled and compacted with a minimum of 20 overlapping passes, or as determined by Nutting Engineers, per unit area of a vibratory compactor imparting a minimum dynamic force of 10 tons. The roller coverages should be equally divided into two perpendicular directions. The vibratory roller should operate at the high frequency level at a maximum speed of 2 feet per second.

Fill Placement

The fill to be placed prior to performance of vibrocompaction should consist of fine sand with less than 10% passing the No. 200 sieve, free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition and placement.

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils, and to determine if the fill material is acceptable.

Shallow Foundations

Once the site preparation recommendations presented herein have been implemented, the structure may be supported using conventional spread foundations. These foundations may be proportioned for an allowable bearing pressure of 5,000 pounds per square foot (psf).

To provide an adequate factor of safety against a shearing failure in the sub soils, the bottoms of conventional spread footings should be based not less than 12 inches below final grade. We recommend a minimum width of 24 inches for continuous footings and 36 inches for individual footings, even though the soil bearing pressure may not be fully developed in all cases.

The shallow foundations should be designed and constructed in accordance with the Florida Building Code. The following sections present design criteria for foundations and our recommendations for site preparation and foundation construction.

Foundation Settlement

Shallow foundations designed and constructed in accordance with the recommendations of this report are estimated to sustain a maximum long-term total settlement of less than approximately one inch. Settlement of the foundations will occur as an elastic response of the soil to the building loads applied. In this case, nearly all of the settlement of the foundations is expected to take place during construction.

Differential settlement between adjacent foundations should be approximately one-half of the total settlement. Distortions that occur along the wall footings due to differential settlement should not be more than 1 in 500.

Floor Slab Recommendations

It is our opinion that the floor slab system may be constructed as a slab on grade after the soils are improved as stated above. We recommend that a vapor barrier be placed between the soil and concrete. We also recommend that at a minimum, reinforcing steel mesh be placed in the ground floor slab. The structural engineer should be contacted for additional floor slab reinforcement requirements.

A representative number of in-place field density tests should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained.

Excavation Requirements

Excavations of five feet or more in depth should be sloped or shored in accordance with OSHA and State of Florida requirements. Materials removed from any excavation should not be

stockpiled immediately adjacent to the open excavation as this load may cause a sudden collapse of the sidewalls.

GENERAL INFORMATION

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils, and to determine if the fill material is acceptable.

A representative number of in-place field density tests should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained.

We suggest that the Geotechnical Engineer inspect and approve all foundation bearing surfaces and floor sub-grades prior to placement of reinforcing steel, concrete or pavement.

The vibratory compaction equipment will cause vibrations that could be felt by persons within adjacent buildings and may cause cosmetic damage to the structures. The contractor should exercise due care during performance of the vibratory compaction work.

The assessment of the site environmental conditions or the presence of pollutants in the soil, rock or groundwater of the site is beyond the proposed scope of this exploration. If you desire, ***Nutting Environmental of Florida, Inc.***, can perform an environmental assessment of the project site.

Changes in the submitted project details or the discovery of any site or varying subsurface conditions prior to and/or during construction which deviate from the data obtained in this exploration should be immediately reported to us so that the condition or change can be evaluated and appropriate action taken. We request the opportunity to review the final plans and specifications to assure that the intent of the recommendations of this report is properly interpreted and incorporated.

Our client for this geotechnical evaluation was:

City of Hallandale Beach
400 South Federal Highway
Hallandale Beach, Florida 33009

This report is prepared exclusively for the use of the ***client*** and other members of the design team for specific application to this project at the above referenced site. The conclusions provided by ***Nutting Engineers of Florida, Inc.***, are based solely on the information presented in this report.

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

The recommended construction phase inspection by the Geotechnical Engineer will provide continuity in the implementation and interpretation of the recommendations contained in this report. For this reason, we believe that this inspection service should be provided by ***Nutting Engineers of Florida, Inc.*** We would also like to offer our services for quality control testing and inspection of proposed construction, i.e., foundation bearing surfaces, soils, concrete, steel and roofing materials as well as threshold inspections.

We appreciate the opportunity to provide these services for you and look forward to completing this and other projects with you. If we can be of any further assistance with the design or construction services, or if you need additional information, please feel free to contact us at your convenience.

Sincerely,
NUTTING ENGINEERS OF FLORIDA, INC.

7/30/14

Paul C. Catledge, P.E. #68448
Senior Engineer

Attachments: Boring Location Plan
Test Boring Reports (1-3)
Exfiltration Test Results (1-3)
Soil Classification Criteria
Limitations of Liability

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ESTABLISHED 1967

CITY OF HALLANDALE BEACH
MAIN FIRE STATION
NW 5TH ST & NW 1ST AVE.
HALLANDALE BEACH, FLORIDA

APPROXIMATE TEST LOCATIONS

NOT TO SCALE

FIGURE 1

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Boynton Beach, FL 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-1

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

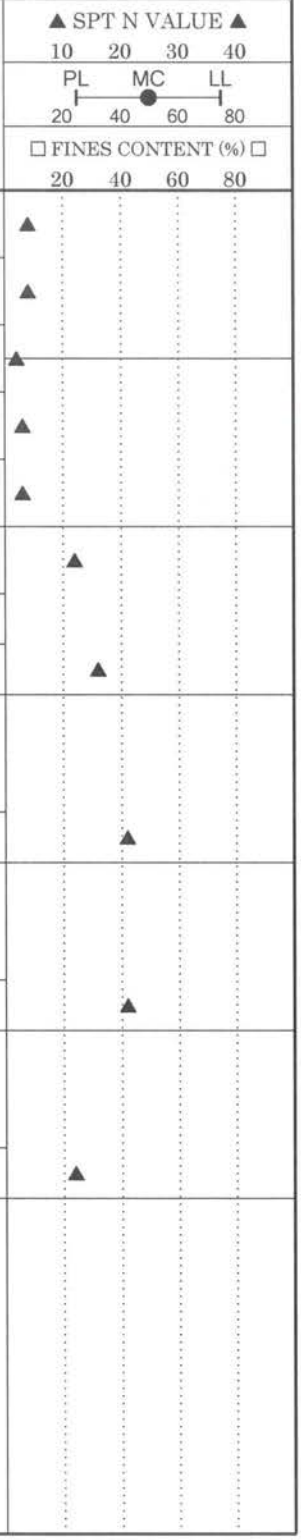
DATE STARTED 7/10/14 COMPLETED 7/10/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ∇ AT TIME OF DRILLING 5.5 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	1-2-2-3	**4**
			2	3-2-2-2	**4**
		Brown quartz fine SAND			
5		∇	3	1-1-1-1	**2**
		Tan quartz fine SAND, some limestone fragments	4	1-1-2-2	**3**
			5	1-1-2-4	**3**
10		Lt. brown quartz fine SAND	6	2-5-7-10	**12**
15			7	6-8-8	**16**
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS			
20			8	8-10-11	**21**
25			9	7-9-12	**21**
30			10	6-6-6	**12**
		Bottom of hole at 30.0 feet.			



TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

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BORING NUMBER B-2

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

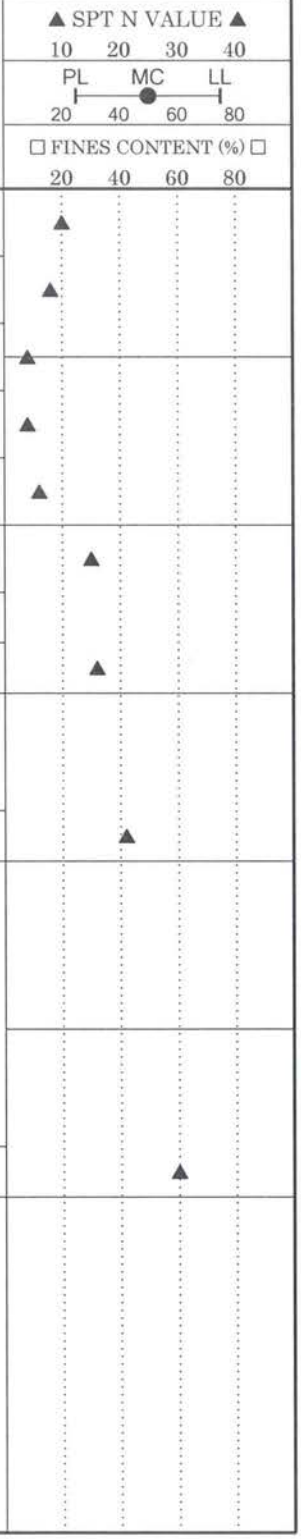
DATE STARTED 7/7/14 COMPLETED 7/7/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ∇ AT TIME OF DRILLING 7.0 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	4-5-5-5	**10**
			2	4-4-4-3	**8**
5		Dk. brown quartz fine SAND	3	1-2-2-2	**4**
		Brown quartz fine SAND			
		∇ Lt. brown quartz fine SAND	4	1-2-2-3	**4**
			5	2-3-3-4	**6**
10					
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS	6	6-7-8-10	**15**
15			7	7-7-9	**16**
20			8	6-12-9	**21**
25					
30			9	7-10-20	**30**
		Bottom of hole at 30.0 feet.			



TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

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BORING NUMBER B-3

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

DATE STARTED 7/10/14 COMPLETED 7/10/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ▽ AT TIME OF DRILLING 5.5 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	1-2-2-3	**4**
			2	2-3-3-3	**6**
5		▽	3	2-1-1-1	**2**
		Dk. brown quartz fine SAND			
		Brown quartz fine SAND	4	1-1-2-2	**3**
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS	5	5-6-6-7	**12**
10			6	6-7-7-9	**14**
15			7	6-7-7	**14**
20			8	6-7-9	**16**
25			9	7-14-10	**24**
30			10	6-8-12	**20**
		Bottom of hole at 30.0 feet.			

▲ SPT N VALUE ▲ 10 20 30 40

PL MC LL 20 40 60 80

□ FINES CONTENT (%) □ 20 40 60 80

TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	1
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-5'	Lt. tan quartz fine SAND
5'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	3.2
2	3.1
3	3.0
4	3.0
5	3.0
6	3.0
7	3.0
8	3.0
9	3.0
10	3.0

$K = 2.27 \times 10^{-4}$ cfs/ft^{2}ft.head

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	2
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-4'	Lt. tan quartz fine SAND
4'-5'	Dk. brown quartz fine SAND
5'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	16.4
2	16.3
3	16.0
4	16.0
5	16.0
6	16.0
7	16.0
8	16.0
9	16.0
10	16.0

$K = 1.21 \times 10^{-3}$ cfs/ft^{2}ft.head

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	3
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-4'	Lt. tan quartz fine SAND
4'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	4.3
2	4.3
3	4.2
4	4.2
5	4.2
6	4.2
7	4.2
8	4.2
9	4.2
10	4.2

$K = 3.18 \times 10^{-4}$ cfs/ft^{2}ft.head

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SOIL AND ROCK CLASSIFICATION CRITERIA

SAND/SILT

N-VALUE (bpf)	RELATIVE DENSITY
0 – 4	Very Loose
5 – 10	Loose
11 – 29	Medium
30 – 49	Dense
>50	Very dense
100	Refusal

CLAY/SILTY CLAY

N-VALUE (bpf)	UNCONFINED COMP. STRENGTH (tsf)	CONSISTENCY
<2	<0.25	v. Soft
2 – 4	0.25 – 0.50	Soft
5 – 8	0.50 – 1.00	Medium
9 – 15	1.00 – 2.00	Soft
16 – 30	2.00 – 4.00	v. Stiff
>30	>4.00	Hard

ROCK

N-VALUE (bpf)	RELATIVE HARDNESS	ROCK CHARACTERISTICS
N≥ 100	Hard to v. hard	Local rock formations vary in hardness from soft to very hard within short vertical and horizontal distances and often contain vertical solution holes of 3 to 36 inch diameter to varying depths and horizontal solution features. Rock may be brittle to split spoon impact, but more resistant to excavation.
25≤ N ≤ 100	Medium hard to hard	
5≤ N ≤ 25	Soft to medium hard	

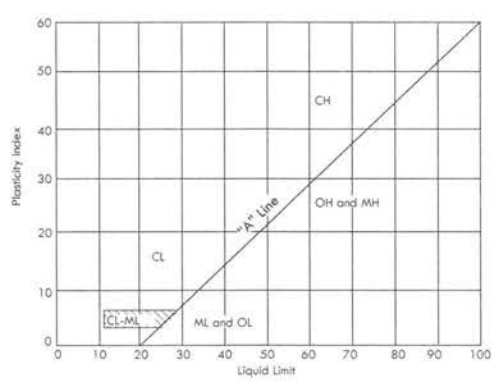
PARTICLE SIZE

Boulder	>12 in.
Cobble	3 to 12 in.
Gravel	4.76 mm to 3 in.
Sand	0.074 mm to 4.76 mm
Silt	0.005 mm to 0.074 mm
Clay	<0.005 mm

DESCRIPTION MODIFIERS

0 – 5%	Slight trace
6 – 10%	Trace
11 – 20%	Little
21 – 35%	Some
>35%	And

Major Divisions			Group Symbols	Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gavels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than five percent.....GW, GP, SW, SP; More than 12 percent.....GM, GC, SM, SC; 5 to 12 percent.....Borderline cases requiring dual systems**	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GW* d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
						Atterberg limits above "A" line with P.I. greater than 7	
			GC	Clayey gravels, gravel-sand-clay mixtures			
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM* d / u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual system.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. more than 7	
Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy, clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays or high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		PT	Peat and other highly organic soils			



Plasticity Chart

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LIMITATIONS OF LIABLILITY

WARRANTY

We warranty that the services performed by Nutting Engineers of Florida, Inc. are conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession in our area currently practicing under similar conditions at the time our services were performed. ***No other warranties, expressed or implied, are made***. While the services of Nutting Engineers of Florida, Inc. are a valuable and integral part of the design and construction teams, we do not warrant, guarantee or insure the quality, completeness, or satisfactory performance of designs, construction plans, specifications we have not prepared, nor the ultimate performance of building site materials or assembly/construction.

SUBSURFACE EXPLORATION

Subsurface exploration is normally accomplished by test borings; test pits are sometimes employed. The method of determining the boring location and the surface elevation at the boring is noted in the report. This information is represented in the soil boring logs and/or a drawing. The location and elevation of the borings should be considered accurate only to the degree inherent with the method used and may be approximate.

The soil boring log includes sampling information, description of the materials recovered, approximate depths of boundaries between soil and rock strata as encountered and immediate depth to water data. The log represents conditions recorded specifically at the location where and when the boring was made. Site conditions may vary through time as will subsurface conditions. The boundaries between different soil strata as encountered are indicated at specific depths; however, these depths are in fact approximate and dependent upon the frequency of sampling, nature and consistency of the respective strata. Substantial variation between soil borings may commonly exist in subsurface conditions. Water level readings are made at the time and under conditions stated on the boring logs. Water levels change with time, precipitation, canal level, local well drawdown and other factors. Water level data provided on soil boring logs shall not be relied upon for groundwater based design or construction considerations.

LABORATORY AND FIELD TESTS

Tests are performed in *general* accordance with specific ASTM Standards unless otherwise indicated. All criteria included in a given ASTM Standard are not always required and performed. Each test boring report indicates the measurements and data developed at each specific test location.

ANALYSIS AND RECOMMENDATIONS

The geotechnical report is prepared primarily to aid in the design of site work and structural foundations. Although the information in the report is expected to be sufficient for these purposes, it shall not be utilized to determine the cost of construction nor to stand alone as a construction specification. Contractors shall verify subsurface conditions as may be appropriate prior to undertaking subsurface work.

Report recommendations are based primarily on data from test borings made at the locations shown on the test boring reports. Soil variations commonly exist between boring locations. Such variations may not become evident until construction. Test pits sometimes provide valuable supplemental information that derived from soil borings. If variations are then noted, the geotechnical engineer shall be contacted in writing immediately so that field conditions can be examined and recommendations revised if necessary.

The geotechnical report states our understanding as to the location, dimensions and structural features proposed for the site. ***Any significant changes of the site improvements or site conditions must be communicated in writing to the geotechnical engineer immediately*** so that the geotechnical analysis, conclusions, and recommendations can be reviewed and appropriately adjusted as necessary.

CONSTRUCTION OBSERVATION

Construction observation and testing is an important element of geotechnical services. The geotechnical engineer's field representative (G.E.F.R.) is the "owner's representative" observing the work of the contractor, performing tests and reporting data from such tests and observations. ***The geotechnical engineer's field representative does not direct the contractor's construction means, methods, operations or personnel.*** The G.E.F.R. does not interfere with the relationship between the owner and the contractor and, except as an observer, does not become a substitute owner on site. The G.E.F.R. is responsible for his/her safety, but has no responsibility for the safety of other personnel at the site. The G.E.F.R. is an important member of a team whose responsibility is to observe and test the work being done and report to the owner whether that work is being carried out in general conformance with the plans and specifications. The enclosed report may be relied upon solely by the named client.

SECTION 018113 - LEED REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Silver certification based on the Group Project requirements of LEED 2009 BD+C, Version 3.

1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. A copy of the LEED Project checklist is attached at the end of this Section for information only.

1.3 DEFINITIONS

A. Blower Door Test: A special instrument used to measure air leakage in a building and its ductwork. The equipment is made of a temporary door covering which is installed in an outside doorway and a blower which forces air into or out of the building. The blower door measures how leaky the building and ductwork are, and can be used to find the location of the major leaks

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-FSC-accredited certification body.

C. LEED: Leadership in Energy & Environmental Design.

D. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

E. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site (or equivalent mileage using Option 2 below). If only a fraction of a product or material is extracted/harvested/recovered and manufactured

locally, then only that percentage (by weight) shall contribute to the regional value. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in the calculations. Travel Distance for Regional Materials is defined two ways:

1. Option 1: All Materials or products have been extracted, harvested or recovered, as well as manufactured within a 500 mile radius of the project site.
2. Option 2: Building Materials or products shipped by rail or water have been extracted, harvested or recovered, as well as manufactured within 500 miles total travel distance of the project site using a weighted average determined through the following formula: (Distance by rail / 3) + (Distance by sea/15) + Distance by all other means) $\leq$ 500 miles.

F. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

G. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

H. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

I. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).

1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

J. Rapidly Renewable Material: Agricultural products, both fiber and animal, that take 10 years or less to grow or raise and can be harvested in a sustainable fashion. The rapidly renewable content value of a material assembly shall be determined by weight. The rapidly renewable material fraction of the assembly is then multiplied by the cost of assembly to determine the rapidly renewable content value.

1.4 REFERENCES

A. The publications listed below form a part of this section to the extent referenced:

1. ASTM INTERNATIONAL (ASTM)
   a. ASTM E 408 (1996) Standard Test Method for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
2. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
   a. 16 CFR 260.7 (e) Guide for the Use of Environmental Marketing Claims.
   b. 40 CFR 59 Protection of Environment: National Volatile Organic Compound Emission.
   c. Standards for Consumer and Commercial Products.
3. Prerequisite SS 1.0: Erosion and Sediment Control Plan.

1.5 SUBMITTALS

A. Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

1. Furniture.
2. Plumbing.
3. Mechanical.
4. Electrical.
5. Specialty items such as elevators and equipment.
6. Wood-based construction materials.

D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met:

1. Prerequisite SS 1.0: Erosion and Sediment Control Narrative, specific to the project site.
2. Credit MR 2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
3. Credit MR 3: List of proposed salvaged and refurbished materials. Identify each material that will be salvaged or refurbished, including its source, cost, and replacement cost if the item was to be purchased new.
4. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
5. Credit MR 5: List of proposed regional materials.
   a. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
   b. Identify each regionally extracted, harvested or recovered material, its source, and cost.

6. Credit MR 7: List of proposed wood products and certified wood products. Indicate each product containing wood, including its certification and cost of wood products.

7. Prerequisite EQp 2: List blower door testing agency. Indicate units to be tested. Indicate date of testing.
8. Credit EQ 3.1: Construction indoor-air-quality management plan.
9. Credit EQ 4.3: List of proposed carpet, carpet cushion and carpet adhesive. List of all hard surface flooring, adhesives, grouts, finishers, and sealers.
10. Credit EQ 4.4: List of composite wood and agrifiber products used in the project. Manufacturer's data demonstrating that the composite wood and agrifiber products are free of urea-formaldehyde and indicating type of binding agent.

E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:

1. Provide updated LEED online 'BD & C Materials and Resources Calculator', available from LEED online credit information tab.
2. Provide (6) six date stamped project photographs of contractor installed and maintained Erosion and Sediment Control Measures monthly until site landscaping is installed and Site is stabilized.
3. Provide as required date stamped photos for Indoor Air Quality Management Plan. Refer to Section 017320 Indoor Air Quality (IAQ) Management Plan.
4. Credit MR 2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
5. Credit MR 3: Salvaged and refurbished materials.
6. Credit MR 4: Recycled content.
7. Credit MR 5: Regional materials.
8. Credit MR 7: Certified wood products to achieve 50% of total wood by cost.

F. LEED Documentation Submittals:

1. Credit SS 7.2: Product Data for roofing materials indicating solar reflectance index.
2. Prerequisite EAp 3 and Credit EA 4: Product Data for new HVAC equipment indicating refrigerants used.
3. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than one year of post-construction occupancy.
4. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."
5. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
6. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
7. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
    a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
    b. Include statement indicating cost and distance from point of extraction, harvest, or recovery to Project for each raw material used in regionally manufactured materials.

c. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in the calculations. Travel Distance for Regional Materials is defined two ways:
   1) Option 1: All Materials or products have been extracted, harvested or recovered, as well as manufactured within a 500 mile radius of the project site.
   2) Option 2: Building Materials or products shipped by rail or water have been extracted, harvested or recovered, as well as manufactured within 500 miles total travel distance of the project site using a weighted average determined through the following formula: (Distance by rail / 3) + (Distance by sea/15) + Distance by all other means) $\leq$ 500 miles.

8. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood.
   a. Material Cost: $ _____ . ___
   b. Material's FSC Pure and FSC Mixed content, _____ . %
   c. Material's FSC Mixed content, _____ . %
   d. Material "FSC Recycled" or "FSC Recycled Credit", counts only in MRc 4 Recycled Material.
   e. Vendor Invoice: Each vendor invoice must conform to the following requirements:
      1. Each wood product must be identified on a line-item basis;
      2. FSC products must be identified as such on a line-item basis;
      3. The $ value of each line item must be shown;
      4. The vendor's COC certificate number must be shown on any invoice that includes FSC products.
9. Prerequisite EQp2: Blower door test results and applicable retesting results.
10. Credit EQ 1: Product Data/cut sheets and Shop Drawings for carbon dioxide monitoring system or flow stations.
11. Credit EQ 3.1:

    a. Construction indoor-air-quality management plan during construction.
    b. Product data for temporary filtration media.
    c. Product data for filtration media used during occupancy.
    d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.

12. Credit EQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
13. Credit EQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
14. Credit EQ 4.3:
    a. Product Data for carpet products including backing, padding and carpeting, indicating VOC content of each product used. Carpet to meet Carpet and Rug Institute Green Label Plus Program. Carpet cushion to meet Carpet and Rug Institute Green Label Program.
    b. Product data for Carpet adhesives, indicating VOC content of each product used.

c. Product data for hard surface flooring, indicating meeting the FloorScore requirements.
d. Product Data for concrete, wood, bamboo and cork floor finishes such as sealers, stain and finish
e. Product data for any site applied adhesives, grouts, finishes and sealers indicating compliance with South Coast Air Quality Management District (SCAQMD) Rule 1113 Architectural Coatings, rules in effective January 1, 2004
f. Product data for any site applied adhesives, grouts, finishes and sealers indicating compliance with South Coast Air Quality Management District (SCAQMD) Rule 1168 VOC Limits effective July 1, 2005 and rule amendment date of January 7, 2005.

15. Credit EQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.
16. Credit EQ 7.1: Product Data and Shop Drawings for sensors and control system used to monitor and control room temperature and humidity.

1.6 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

2. PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.2 SALVAGED AND REFURBISHED MATERIALS

A. Credit MR 3.1: Provide salvaged or refurbished materials for a minimum of 5 percent of building materials (by cost). The following materials may be salvaged or refurbished materials:

1. Refurbished materials from existing building or materials found on-property.

2. Salvaged concrete & brick from existing building on-site.

3. Remanufactured structural steel, rebar and other scrap metal.

4. Salvaged Site hardscape materials.

5. Relocated plant materials.

6. Other reused materials found to be in accordance with the LEED BD+C MRc3 requirements.

2.3 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
3. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.4 REGIONAL MATERIALS

A. Credit MR 5: Provide a minimum of 20 percent of materials (by cost) that are regionally extracted and manufactured materials.

2.5 CERTIFIED WOOD

A. Credit MR 7: Provide a minimum of 50 percent (by cost) of wood-based materials that are 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. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

   a. Rough carpentry.
   b. Miscellaneous carpentry.
   c. Heavy timber construction.
   d. Wood decking.
   e. Metal-plate-connected wood trusses.
   f. Structural glued-laminated timber.
   g. Finish carpentry.
   h. Architectural woodwork.
   i. Wood paneling.
   j. Wood veneer wall covering.
   k. Wood Doors.
   l. Wood flooring.
   m. Wood lockers.
   n. Wood cabinets.
   o. Furniture.

2.6 LOW-EMITTING MATERIALS

A. Credit EQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:

1. Wood Glues: 30 g/L.
2. Metal to Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.
4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L.
21. Plastic Cement Welding Compounds: 250 g/L.
22. ABS Welding Compounds: 325 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 550 g/L.
26. Plastic Cement Welding Compounds: 350 g/L.
27. ABS Welding Compounds: 400 g/L.
28. CPVC Welding Compounds: 490 g/L.
29. PVC Welding Compounds: 510 g/L.
30. Adhesive Primer for Plastic: 650 g/L.
31. Sheet Applied Rubber Lining Adhesive: 850 g/L.
32. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
33. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
34. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
35. Other Adhesives: 250 g/L.
36. Architectural Sealants: 250 g/L.
37. Nonmembrane Roof Sealants: 300 g/L.
38. Single-Ply Roof Membrane Sealants: 450 g/L.
39. Other Sealants: 420 g/L.
40. Sealant Primers for Nonporous Substrates: 250 g/L.
41. Sealant Primers for Porous Substrates: 775 g/L.
42. Modified Bituminous Sealant Primers: 500 g/L.

43. Other Sealant Primers: 750 g/L.

B. Credit EQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D and the following chemical restrictions:

1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC not more than 150 g/L.
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
6. Floor Coatings: VOC not more than 100 g/L.
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Shellacs, Pigmented: VOC not more than 550 g/L.
9. Stains: VOC not more than 250 g/L.
10. Flat Interior Topcoat Paints: VOC not more than 50 g/L.
11. Nonflat Interior Topcoat Paints: VOC not more than 150 g/L.
12. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
13. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L.
14. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
15. Floor Coatings: VOC not more than 100 g/L.
16. Shellacs, Clear: VOC not more than 730 g/L.
17. Shellacs, Pigmented: VOC not more than 550 g/L.
18. Stains: VOC not more than 250 g/L.
19. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
20. Dry-Fog Coatings: VOC not more than 400 g/L.
21. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
22. Pretreatment Wash Primers: VOC not more than 420 g/L.
23. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
24. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.

q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

C. Credit EQ 4.4: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

3. EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Sections.

B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 21 Section "Clean-Agent Fire Extinguishing Systems" for additional requirements.

3.2 MEASUREMENT AND VERIFICATION

A. Credit EA 5: Implement measurement and verification plan consistent with Option B: Energy Conservation Measure Isolation or Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction.

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.4 BLOWER DOOR TESTING

A. Prerequisite EQp2: Blower Door Test verifies that smoke will not penetrate into other areas of the building. This requires proper sealing of all penetrations in ceilings, walls, and floors, and blower door testing verifies the design and construction compliance.

B. Guidelines for performing blower door testing require that you follow ANSI/ASTM-E779-03 Standard Test Method and that sampling be performed in accordance with progressive sampling methodology defined in Ch. 4 of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards. A CIR ruling for multi-family buildings allows for random sampling in one of every seven units. Results must demonstrate less than 1.25 square inches leakage area per 100 square feet of enclosure area (sum of all wall, ceiling, and floor areas).

C. Blower Door Preparation:
   1. Close all windows.
   2. Close all exterior doors (except the door with the fan)
   3. Open all interior doors.
   4. Disable heating equipment and non-electric water heaters by turning down their thermostats. Shut all fireplace dampers.
   5. Turn off the clothes dryer and all bathroom and kitchen exhaust fans.
   6. Fill all the plumbing traps with water.

3.5 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit EQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction, Second Edition 2007, Chapter 3."

B. Refer to Section 018119 Indoor Air Quality (IAQ) Management Plan, for requirements.

3.6 CONTRACTOR LEED LETTER TEMPLATES

A. Contractor is responsible for completing and documenting the following LEED Letter Templates on line at www.usgbc.org/leedonline .Contractor to refer to USGBC, BDC Material and Resource Calculator at http://www.usgbc.org/resources/bdc-material-and-resource-calculator
   1. SSp1: Construction Activity Pollution Prevention. Document implementation record keeping and photographs.
   2. Credit MR 2: Construction Waste Management.
   3. Credit MR 3 Materials Reuse
   4. Credit MR 4: Recycled Content.
   5. Credit MR 5: Regional Materials.
   6. Credit MR 7: Certified Wood.
   7. Credit EQ 3.1: Construction IAQ Management Plan: During Construction.
   8. Credit EQ 4.1: Low-Emitting Materials: Adhesives and Sealants.
   9. Credit EQ 4.2: Low-Emitting Materials: Paints and Coatings.
   10. Credit EQ 4.3: Low-Emitting Materials: Flooring Systems.
   11. Credit EQ 4.4: Low-Emitting Materials: Composite Wood and Agrifiber.

END OF SECTION 018113

SECTION 018119 INDOOR AIR QUALITY (IAQ) MANAGEMENT REQUIREMENTS

1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements and procedures for achieving acceptable indoor air quality for the interior areas of this Project during construction, and preventing contamination of ductwork, HVAC equipment, and other building materials to avoid IAQ problems for workers and for occupants in the future after occupancy. Work includes requirements on the use of permanent building mechanical systems prior to Owner's acceptance.

B. Comply with requirements for LEED IEQc3.1 Indoor Air Quality Management, During Construction and as specified in this Section.

C. Contractor shall prepare and submit an Indoor Air Quality (IAQ) Management Plan.

1.3 SUBMITTALS

A. IAQ Construction Management Plan: Submit the plan within 30 days of the date established for commencement of the Work. Update and resubmit plan as required during construction process to reflect Project conditions.

B. Meeting Minutes: Submit minutes from the Contractor meetings related to the execution and verification of the IAQ Construction Management Plan.

C. Date stamped record photographs: Provide at a minimum of 3 stages of construction to document adherence with the IAQ requirements. A minimum of 45 photographs, 15 photographs taken at the three different stages of construction when IAQ Construction Management Plan procedures are active. Provide 3 photographs of each of the five SMACNA IAQ requirements at each stage of construction. Provide identification of the 5 SMACNA requirements for each photo to document consistent adherence to requirements of LEED IEQc 3.1 Construction Indoor Air Quality Management, During Construction.

D. Product Data: Submit cut sheets of filtration media proposed for use.

E. LEED Submittal: LEED Templates / Forms for Credit IEQc 3.1 Construction Indoor Air Quality Management, During Construction completed on line, signed / initialed by the Contractor, with copy of Construction IAQ Plan and a statement that requirements for the credit have been met.

1.4 QUALITY ASSURANCE

A. Contractor's Construction IAQ Management Plan shall meet or exceed the 5 recommended design approaches of SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction 2nd Edition 2007, ANSI/SMACNA 008-2008, (Chapter 3), and shall embody the principals and practices set forth in this Section.

B. IAQ Management Conference: Conduct conference at Project site to comply with the requirements in Division 1 Section "Project Management and Coordination."

1. Review methods and procedures related to IAQ management during construction.
2. Review IAQ management requirements with each trade.

C. Comply with the requirements of LEED IEQC 3.1 Construction Indoor Air Quality Management, During Construction and Contractor's Construction IAQ Management Plan during construction.

1.5 IAQ CONSTRUCTION MANAGEMENT PLAN

A. Contractor IAQ Construction Management Plan shall include procedures to prevent indoor air quality problems resulting from the construction process in order to help sustain the comfort and well being of construction workers and future building occupants.

B. Contractor's detailed plan shall be based on the particular characteristics of the Project.

2. PRODUCTS (Not Used)

3. EXECUTION

3.1 HVAC PROTECTION (SMACNA Approach number 1)

A. Store HVAC equipment including but not limited to items such as ducting, registers, air handler components, fans, and motors in a clean, dry location, protected from dust and other contaminants, and covered with plastic until installed

B. Seal all HVAC inlets and outlets.

C. Use of the HVAC system shall be avoided during construction, until drywall construction and activities that produce dust or particulate pollution have been completed. Temporary ventilation may be installed to remove contaminants. All HVAC components including but is not limited to outside air inlets, grills, diffusers, supply ducts, return ducts, ceiling plenums, VAV (variable air volume) plenum intakes, and window ventilator or air conditioning units shall be sealed during construction.

D. Seal HVAC components during installation. Ducts runs that require several days to install, sections shall be sealed off as they are completed. Seals shall be removed prior to continuing the duct run. Other components of the HVAC system shall be subject to the same requirements to protect from contamination.

E. Provide frequent inspection and maintenance, of HVAC component protection. Replace as necessary. If inspections by the Architect, Engineer, Owner, or Commissioning Agent reveal that the ductwork has been contaminated due to inadequate protection, the ductwork shall be cleaned professionally prior to activation the HVAC system or occupancy, using procedures established in ACR 2005 published by the National Air Duct Cleaners Association. HVAC components have been damaged or contaminated shall be cleaned or replaced as necessary.

F. Use temporary filtration media. If HCAC system is to be used while construction work is being done, temporary media filtration media shall be installed on all air intakes. Such filtration shall have a minimum filtration efficiency (Minimum Efficiency Reporting Value-MERV per ASHRAE 52.2) of 8. For air intakes into other parts of the building that are very sensitive, such as computer rooms, filtration media with a MERV rating of 13 or higher is required. New filtration with a MERV 13 shall be installed prior to occupancy.

G. Inspect filters weekly replace as needed for proper filtration and air flow.

H. Avoid contamination of air entry into enclosed parts of the building. When outdoor construction activities generate dust, combustion emissions, or other contaminates, operable windows and outside air supplies to enclosed portions of the building will be closed or sealed.

I. Do not use fan, mechanical, or electrical rooms to store construction or waste materials. Keep these rooms clean and neat.

J. Ceiling tiles shall not be installed until after drywall and painting is complete to avoid contamination of ceiling tiles that will form the return air plenum.

3.2 SOURCE CONTROL(SMACNA Approach number 2)

A. The use of moisture-damaged materials shall not be allowed. Any porous materials that have become wet shall be dried thoroughly within 48 hours and before installation. Any materials damaged, showing visible mold, or that are wet for over 48 hours shall be removed from the site appropriately.

B. Contractor to ensure that the construction process will not result in moisture intrusion. In the event of rain or groundwater intrusions notify the Owner’s representative.

C. Avoid tracking pollutants into the work areas.

1. At the start of framing and mechanical system installation access to the building shall be controlled to minimize the tracking of contaminants.
2. Material deliveries and construction waste removal shall be routed by the most direct route to and from the building exterior.
3. Provide rough track off grates or matting at the entryway to remove moisture and contaminants from pedestrian traffic.
4. Prevent the ingress of rodents and pests.
5. Food and drinks other than water shall not be allowed in the building.
6. Trash containers will be primarily located outside of the building. Any interior trash containers will be emptied twice a week at a minimum.
7. Use procedures to insure that there is no smoking in the building, storage areas of absorptive materials, or within 25 ft of air intakes or building openings.

D. Limit construction traffic and monitor idling vehicles and equipment in the vicinity of air intakes when the HVAC systems are activated. Restrict vehicles to a loading area, well removed from air intakes. Prevent emissions from being drawn into the building.

E. Use electric or natural gas alternatives to for gasoline and diesel equipment when possible.

F. All personnel lifts used inside the building will be electrically operated to prevent emissions inside the building.

G. Cycle vehicles and equipment off when not being used.

H. Avoid the use of materials and products with high VOC and particulate levels. Inside the building use products and installation methods with low VOCs such as paints and coatings, adhesives and sealants, and cleaners.

I. The project's specifications/LEED guidelines call for the use of low-VOC materials. Daily inspections will be made by the Contractor's project manager and/or superintendent to ensure the products being used in the field are the specified and approved products.

J. Keep containers of wet products closed when not in use. Cover and seal materials which can release odor or dust.

K. Containers of fuel, volatile liquids, and materials with high VOC content shall be tightly sealed and stored outside of the building.

L. Protect absorbent materials from moisture during delivery to and storage at the job site. Store materials in a dry and clean environment.

3.3 PATHWAY INTERUPTION (SMACNA Approach number 3)

A. Use dust curtains or temporary enclosures to prevent dust from migrating to other areas when applicable. During construction, isolate areas of work to prevent contamination of clean or occupied areas.

B. Keep pollutant sources as far away as possible from absorptive materials, ductwork, and areas occupied by workers.

C. Isolate work areas and or create pressure differentials to prevent the migration of contaminants.

D. Use portable fan systems to exhaust contaminated air directly to the outside of the building, and discharge the air to prevent recirculation.

3.4 HOUSE KEEPING (SMACNA Approach number 4)

A. Keep HVAV components, not limited to coils, air filters, dampers, fans, and ductwork, clean during installation, and clean them as required prior to performing the testing, adjusting and balancing of the systems.

B. Construction shall minimize the production and accumulation of dust and other contaminants. Use integral dust collection systems on drywall sanders, cut saws, and routers. Confine dust-

generation activities to areas where cleaning can be carried out easily and where contaminants will not be tracked or contaminate other areas.

C. Wetting agents or sweeping compounds shall be used to keep dust from becoming airborne.

D. Wet cloths, damp mops, and vacuum cleaners with high efficiency particulate (HEPA) filters shall be used to clean. Cleaning frequency shall be increased when dust accumulation is noted.

E. All spills and excess applications of solvent-containing products shall be cleaned using approved methods immediately. Water spills shall be cleaned-up promptly.

F. Avoid accumulation of water inside the building and promptly remove any water that may occur. Protect porous materials such as insulation, ceiling tiles and drywall from water or moisture.

G. Construction areas shall be kept dry. Promptly repair any leaks or penetrations that allow water to enter the building. Use dehumidification as necessary for prompt drying of wet surfaces and materials.

H. Clean rough track off grates or matting at the entryway as necessary, at a minimum weekly to reduce dirt and particulates from entering the building, when building is enclosed.

I. Cleaning Agents: Use Cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable use products that comply with the California Code of Regulations maximum allowable VOC levels.

3.5 SQUENCING AND SCHEDULING (SMACNA Approach number 5)

A. Schedule the installation of porous materials after enclosure of the building. Porous materials shall not be installed until the building envelope is fully weather tight.

B. Install porous or absorbent materials such as ceiling tiles, after odorous activities including drywall installation, painting, and floor finishing is completed.

C. Do not allow contaminants from an area under construction to enter the HVAC systems or to migrate to completed areas of construction.

D. Install MERV 8 filters prior to the FF&E move-in and occupancy.

E. Install furnishing after interior finishes have applied and fully cured.

F. Provide adequate ventilation during curing period. To aid in curing of interior finishes and other products used during construction and to remove pollutants after drywall installation is complete provide adequate ventilation with 100% outside air, and proper filtration for any HVAC components activated. During humid periods or when high moisture materials are present, supplementary dehumidification may be required.

G. All sanding of the concrete floors, floor preparation, and the poured-in-place terrazzo will be scheduled before the HVAC system startup.

H. All drywall sanding and painting will be scheduled before the HVAC system startup.

I. Install MERV 8 filters prior to the FF&E move-in and occupancy.

J. Move-in of all FF&E will occur after all construction activities have been substantially completed and the HVAC has been tested and balanced.

3.6 MONITORING AND IMPLEMENTATION OF IAQ PLAN

A. Contractor to designate an on-site responsible staff member for instructing personnel and overseeing the Construction IAQ Management Plan.

B. Implementation and distribution of the Construction IAQ Management Plan as approved by LEED Manager.

C. Provide weekly Contractor site co-ordination meetings with subcontractors. Review appropriate components of the IAQ Construction Management Plan as a regular action item. Document the implementation of the Plan in the meeting minutes, and update the IAQ Construction Management Plan as required.

D. Subcontractors and their employees shall be provided instruction and Training in the Indoor Air Quality (IAQ) Management Plan.

E. Recording format: Use SMACNA IAQ Guidelines Appendix C (Planning Checklist) and Appendix D (Inspection Checklist) as a guide.

F. Project-specific posters and signage will be posted in the jobsite office trailer, at all building entrances, and at several locations inside the building. The signage will clearly identify LEED guidelines for subcontractors.

END OF SECTION 018119

SECTION 019113 – FUNDAMENTAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. OPR and BOD documentation are available upon request for reference and information only.

1.2 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.3 DEFINITIONS

A. BOD: Basis of Design: A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Agent (CxA): Owner compensated independent agent, not otherwise associated with the Commissioning team members or the Contractor. The CxA directs and coordinates the day-to-day commissioning activities.

C. Cx: Commissioning, the process of ensuring that systems are designed, installed, functionally tested, capable of being operated and maintained to perform in conformity with the Owner's project requirements.

D. Commissioning Plan: Overall plan that provides the structure, schedule and coordination planning for the commissioning process.

E. Functional Performance Test: Test of the function and operation of equipment and systems. Functional testing is the dynamic and interactive testing of systems under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. The commissioning agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is performed by the installing contractor or vendor. Functional tests are performed after prefunctional checklists and startups are completed. Functional Performance Testing is not traditional air or water test and balancing.

F. Prefunctional Checklist: A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Contractor. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation. Some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist. The commissioning process requires that the procedures be documented in writing, and that CxA witness much of the prefunctional work and all of the larger or more critical pieces of equipment.

G. OPR: Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

H. Startup: Initial starting or activating of dynamic equipment, including executing prefunctional checklists.

I. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner: Include CxA, Representatives of the facility user and operation and maintenance personnel, and Architect and engineering design professionals.

1.5 SUBMITTALS

A. Documents: For all systems to be commissioned, the following shall be distributed to the CxA prior to equipment purchase and concurrently with Architect and Engineer of Record. CxA’s review of submittal does not alter the scope or responsibility of the Architect or the Engineer of Record.

1. Manufacture’s cut sheets.
2. Performance data including but not limited to the following:
   a. Fan curves.
   b. Pump curves.
3. Installation and startup manual.
4. Operation, troubleshooting, and maintenance manuals.
5. Shop drawings.

B. Documents: For all systems to be commissioned, the following shall be distributed to the CxA prior to the drafting of Prefunctional Checklists and Functional Test Procedures.

1. Sequence of operations including but not limited to the following:.
   a. An overview narrative of the system describing its purpose, components and function.
   b. All interactions and interlocks with other systems.
   c. Detailed delineation of control between any packaged controls and the building automation system.
   d. Written sequences of control for packaged controlled equipment.
   e. Start-up sequences.
   f. Warm-up mode sequences.
   g. Normal operating mode sequences.
   h. Unoccupied mode sequences.
   i. Shutdown sequences.
   j. Temperature and pressure control: setbacks, setups, resets.
   k. Effects of power or equipment failure with all standby component functions.
   l. All alarms and emergency shut downs.
   m. Seasonal operational differences and recommendations.
   n. Initial and recommended values for all adjustable settings, set-points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, and delays~~,~~ that shall be useful during testing and operating the equipment.
   o. Schedules.
2. Factory test reports.
3. Start-up and checkout materials that are shipped inside the equipment and the field checkout sheet forms to be used by the factory or field technicians.
4. Pipe flushing procedures.
5. Test and balance plan.
6. Test and balance reports.
7. Training Plan: Provide plan for and presentation materials related to training of building personnel on the commissioned systems.
8. Warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
9. Updated as-built versions of the control drawings and sequences of operation.

C. Provide the CxA with requested additional documentation in order to complete the commissioning process.

1.6 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BOD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.7 CONTRACTOR’S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held as needed.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete paper construction checklists as Work is completed and provide electronic copy to the Commissioning Authority on a monthly basis.
7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
8. Complete current Architect, Engineer of Record, and Issues Log punch list items before functional testing.
9. Complete commissioning process test procedures.

1.8 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Witness systems, assemblies, equipment, and component startup.

G. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

H. The CxA will be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required Prefunctional and Functional performance testing shall be provided by the Division 23 and 26 Sub-Contractors for the equipment and control systems being tested.

PART 3 - EXECUTION

3.1 PREFUNCTIONAL CHECKOUT

A. Execution of Prefunctional Checklists and Startup.

1. Seven days prior to startup, the Contractor through the Subs and vendors shall schedule startup and checkout with the CxA. The performance of the Prefunctional checklists, startup and checkout are executed by the Contractor's Sub or vendor. When executing Prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA will observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used.
3. For lower-level components of equipment, such as, VAV boxes, sensors, controllers, the CxA will observe a sampling of the Prefunctional and start-up procedures.
4. The Contractor shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and Prefunctional tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the Prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

B. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. Contractor shall clearly list any outstanding items of the initial start-up and Prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
2. Contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report.

3.2 CONTROLS CHECKOUT

A. Contractor shall notify CxA of controls check-out procedures 7 days prior to work being preformed. At completion of controls checkout, Contractor shall provide CxA with any checklists and/or summary reports.

3.3 TAB

A. TAB shall be preformed after controls check-out has been approved by the CxA.

B. Contractor shall notify CxA of TAB 7 days prior to the work being performed. At the completion of TAB Contractor shall provide CxA with the Tab report.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. Contractor shall schedule and execute the functional tests. Functional testing is conducted after TAB has been completed and approved by CxA.

3.5 TRAINING OF PERSONNEL

A. Contractor shall schedule and conduct training of Owner designated personnel.

B. Contractor shall record training sessions on video and provide in format acceptable to CxA.

3.6 DEFERRED TESTING

A. Contractor shall provide prefunctional checkout, controls checkout, TAB, functional performance testing and training of personnel for any tests deferred due to reasons of building structure, required occupancy conditions or other deficiency determined by the CxA. These tests shall be conducted in the same manner as non deferred activities.

END OF SECTION 019113

DOCUMENT 023200 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. A geotechnical investigation report for Project, prepared by Nutting Engineering Of Florida, Inc., dated July 30, 2014, is available for viewing as appended to this Document.

C. Related Requirements:
   1. Coordinate with structural requirements.

END OF DOCUMENT 023200

REPORT OF
GEOTECHNICAL EXPLORATION

CITY OF HALLANDALE BEACH – MAIN FIRE STATION
BETWEEN NW 5TH ST. & NW 4TH ST AND
NW 1ST AVE. & NW 2ND AVE.
HALLANDALE BEACH, FLORIDA 33009

FOR

CITY OF HALLANDALE BEACH
400 SOUTH FEDERAL HIGHWAY
HALLANDALE BEACH, FLORIDA 33009

PREPARED BY

NUTTING ENGINEERS OF FLORIDA, INC.
2051 NW 112TH AVE
SUITE NO. 126
MIAMI, FLORIDA 33172

PROJECT NO.: 213.13

JULY 2014

Nutting Engineers
of Florida Inc. | Established 1967
Your Project is Our Commitment

Geotechnical & Construction Materials
Engineering, Testing & Inspection
Environmental Services

Offices throughout the state of Florida

www.nuttingengineers.com info@nuttingengineers.com

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2051 N.W. 112th Avenue, Suite 126
Miami, Florida 33172
305-557-3083
Toll Free: 877-NUTTING (688-8464)
Fax: 305-824-8827
Broward 954-941-8700
Palm Beach 561-736-4900
St. Lucie 772-408-1050
www.nuttingengineers.com

Geotechnical and Construction Materials | Engineering, Testing and Inspections | Environmental Services

July 30, 2014

Ms. Sarita Shamah, P.E.
City of Hallandale Beach
400 South Federal Highway
Hallandale Beach, Florida 33009
Phone: (954) 457-2995
Fax: (954) 457-1454
Email: sshamah@hallandalebeachfl.gov

Subject: Report of Geotechnical Exploration
City of Hallandale Beach – Main Fire Station
Between NW 5th St. & NW 4th St and NW 1st Ave. & NW 2nd Ave.
Hallandale Beach, Florida 33009

Dear Ms. Shamah,

Nutting Engineers of Florida, Inc. performed a geotechnical exploration for the proposed Main Fire Station at the above referenced site. The purpose of this exploration was to obtain information concerning the site and subsurface conditions at a specific location in order to provide site preparation and foundation design recommendations for support of the proposed construction. This report presents our findings and recommendations.

PROJECT INFORMATION

Per your electronic transmission dated July 19, 2014, and review of the aerial provided, it is our understanding that plans for this project call for the construction of a new fire station and emergency operation center at the above referenced site. The construction is proposed to have a footprint of approximately 20,000 square feet, and possibly have three stories.

We note that if any of our understandings or assumptions are incorrect, we should be notified so that we can re-evaluate our analysis and may amend our recommendations accordingly.

OFFICES
Palm Beach
Miami-Dade
St. Lucie

GENERAL SUBSURFACE SOIL CONDITIONS

Subsurface Soil Exploration

The exploration of subsurface conditions included site observation, review of the Broward County Soil Survey Map and Standard Penetration Test borings (ASTM D-1586) performed

Nutting Engineers of Florida, Inc. has performed a total of three (3) Standard Penetration Test borings (ASTM D-1586) to depths of 30 feet below the existing ground surface in order to evaluate the subsurface soil conditions. Furthermore, three (3) 'Usual Open-Hole' exfiltration tests were performed in accordance with South Florida Water Management District (SFWMD) specifications to depths of six feet below the existing ground surface.

The locations of the tests are indicated on the attached Boring Location Plan. Individual test boring reports are presented in the Appendix of this report. The test locations were established in the field using approximate methods; namely, a measuring wheel and available surface controls.

Soil Survey Maps Review

A review of the United States Soil Conservation map of Broward County indicates that at the time the survey was conducted, Duette-Urban land complex and Urban Land series were located in the area of the site. These are both described as occurring in areas where the natural soil is mostly covered by pavement or buildings and cannot be readily observed. Fifty to seventy percent of the complex consists of Duette soils that are nearly level, moderately well drained soils on low ridges and knolls in the eastern part of the survey area. The Urban Land series consists of soils in the Hallandale, Margate, Immokalee and Basinger series that have been altered by fill spread on the surface to an average thickness of approximately 12 inches. We note that the maximum depth of the survey is six feet.

Test Boring Results

The appended test boring logs present information and descriptions of the subsurface conditions at each specific test boring location. In general, test boring logs indicate a surface layer of very loose to loose quartz fine sand to depths of approximately eight to seventeen feet, underlain by soft to medium hard tan limestone with silty quartz fine sand to an approximate depth of thirty feet below ground surface, the maximum depth explored.

A detailed description of the soil/rock profile is presented in the test boring records provided in the Appendix. The Standard Penetration Test N-values are used to evaluate the relative density of granular soils. The correlation of penetration resistance with relative density is presented in the Soil Classification Criteria attached in the Appendix.

Ground Water

The immediate groundwater level was measured at the boring locations at the time of drilling. The groundwater level was encountered at an approximate depth of five and a half to seven feet below the existing ground surface. The immediate depth to groundwater measurements presented in this report may not provide a reliable indication of stabilized or longer term depth to groundwater at this site.

Water table elevations can vary dramatically with time through rainfall, droughts, storm events, flood control activities, nearby surface water bodies, tidal activity, pumping and many other factors. For these reasons, this immediate depth to water data **should not** be relied upon alone for project design considerations.

Further information regarding stabilized groundwater elevations at the site could be developed upon specific request. Additional evaluation might include monitoring of peizomenters, survey of the project area for evidence of current groundwater elevation influences such as well fields, obvious construction dewatering, tidal activity, flood control canals and other surface water bodies.

Exfiltration Results

Three 'Usual Open-Hole' exfiltration tests were performed in accordance with South Florida Water Management District (SFWMD) specifications to depths of six feet below the existing ground surface. The tests were performed in order to determine the hydraulic conductivity of the in situ subsurface soils to evaluate drainage requirements for the project, by others.

The hydraulic conductivity values ranged from 1.23×10^{-3} to 2.27×10^{-4} cubic feet per second, per square foot, per foot of head. Detailed soil descriptions and flow rates are presented in the Appendix.

ANALYSIS AND RECOMMENDATIONS

As discussed in the above sections, the soil borings revealed very loose conditions within the upper portion of the soil profile. Supporting the proposed structure on the unamended profile may lead to unacceptable total and differential settlements. We recommend performing a program of vibrocompaction within the proposed construction area and subsequently supporting the proposed fire station on shallow foundations once the operations have been completed. The following sections present our recommendations for vibrocompaction and shallow foundations, as well as related site preparation recommendations.

Vibrocompaction

The vibrocompaction process involves inserting a vibratory flot by water jetting and vibration into the soils. The vibration action causes the granular soils to rearrange in a more densified state. The increase in density of the soils causes a loss of volume; and sands or graded stone are used to replace the lost volume. This technique typically improves the soils to provide an allowable bearing capacity of 4,000 to 8,000 pounds per square foot, depending on equipment power, time, and soil type. The following recommendations are for improvement of the soils to provide for an allowable bearing capacity of 5,000 pounds per square foot.

We recommend that a vibro-flot with a minimum of 175 horsepower be used for this project. We recommend that vibrocompaction points be spaced five to six feet on center within column, wall footing and slab areas, and should be penetrated to at least ten feet below the bottom of the proposed footings, or until refusal of the probe is encountered. During the vibrocompaction operations, verification borings should be performed to evaluate the level of improvement, and verify that the allowable bearing capacity has been achieved.

The vibrocompaction contractor should prepare shop drawings, which indicate the location and depth of the points and equipment to be used. This submittal should be reviewed by Nutting Engineers. It is important that the installation of the vibrocompaction points be installed under the full time observation of the Nutting project geotechnical engineer. This is to ensure that the engineering intent is being satisfied.

Upon completion of the vibrocompaction and satisfactory verification test borings, the entire site should be leveled and compacted with a minimum of 20 overlapping passes, or as determined by Nutting Engineers, per unit area of a vibratory compactor imparting a minimum dynamic force of 10 tons. The roller coverages should be equally divided into two perpendicular directions. The vibratory roller should operate at the high frequency level at a maximum speed of 2 feet per second.

Fill Placement

The fill to be placed prior to performance of vibrocompaction should consist of fine sand with less than 10% passing the No. 200 sieve, free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition and placement.

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils, and to determine if the fill material is acceptable.

Shallow Foundations

Once the site preparation recommendations presented herein have been implemented, the structure may be supported using conventional spread foundations. These foundations may be proportioned for an allowable bearing pressure of 5,000 pounds per square foot (psf).

To provide an adequate factor of safety against a shearing failure in the sub soils, the bottoms of conventional spread footings should be based not less than 12 inches below final grade. We recommend a minimum width of 24 inches for continuous footings and 36 inches for individual footings, even though the soil bearing pressure may not be fully developed in all cases.

The shallow foundations should be designed and constructed in accordance with the Florida Building Code. The following sections present design criteria for foundations and our recommendations for site preparation and foundation construction.

Foundation Settlement

Shallow foundations designed and constructed in accordance with the recommendations of this report are estimated to sustain a maximum long-term total settlement of less than approximately one inch. Settlement of the foundations will occur as an elastic response of the soil to the building loads applied. In this case, nearly all of the settlement of the foundations is expected to take place during construction.

Differential settlement between adjacent foundations should be approximately one-half of the total settlement. Distortions that occur along the wall footings due to differential settlement should not be more than 1 in 500.

Floor Slab Recommendations

It is our opinion that the floor slab system may be constructed as a slab on grade after the soils are improved as stated above. We recommend that a vapor barrier be placed between the soil and concrete. We also recommend that at a minimum, reinforcing steel mesh be placed in the ground floor slab. The structural engineer should be contacted for additional floor slab reinforcement requirements.

A representative number of in-place field density tests should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained.

Excavation Requirements

Excavations of five feet or more in depth should be sloped or shored in accordance with OSHA and State of Florida requirements. Materials removed from any excavation should not be

stockpiled immediately adjacent to the open excavation as this load may cause a sudden collapse of the sidewalls.

GENERAL INFORMATION

Prior to initiating compaction operations, we recommend that representative samples of the structural fill material to be used and acceptable in-place soils be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the structural fill and existing soils, and to determine if the fill material is acceptable.

A representative number of in-place field density tests should be performed in the compacted existing soils and in each lift of structural fill or backfill to confirm that the required degree of compaction has been obtained.

We suggest that the Geotechnical Engineer inspect and approve all foundation bearing surfaces and floor sub-grades prior to placement of reinforcing steel, concrete or pavement.

The vibratory compaction equipment will cause vibrations that could be felt by persons within adjacent buildings and may cause cosmetic damage to the structures. The contractor should exercise due care during performance of the vibratory compaction work.

The assessment of the site environmental conditions or the presence of pollutants in the soil, rock or groundwater of the site is beyond the proposed scope of this exploration. If you desire, ***Nutting Environmental of Florida, Inc.***, can perform an environmental assessment of the project site.

Changes in the submitted project details or the discovery of any site or varying subsurface conditions prior to and/or during construction which deviate from the data obtained in this exploration should be immediately reported to us so that the condition or change can be evaluated and appropriate action taken. We request the opportunity to review the final plans and specifications to assure that the intent of the recommendations of this report is properly interpreted and incorporated.

Our client for this geotechnical evaluation was:

City of Hallandale Beach
400 South Federal Highway
Hallandale Beach, Florida 33009

This report is prepared exclusively for the use of the ***client*** and other members of the design team for specific application to this project at the above referenced site. The conclusions provided by ***Nutting Engineers of Florida, Inc.***, are based solely on the information presented in this report.

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

The recommended construction phase inspection by the Geotechnical Engineer will provide continuity in the implementation and interpretation of the recommendations contained in this report. For this reason, we believe that this inspection service should be provided by ***Nutting Engineers of Florida, Inc.*** We would also like to offer our services for quality control testing and inspection of proposed construction, i.e., foundation bearing surfaces, soils, concrete, steel and roofing materials as well as threshold inspections.

We appreciate the opportunity to provide these services for you and look forward to completing this and other projects with you. If we can be of any further assistance with the design or construction services, or if you need additional information, please feel free to contact us at your convenience.

Sincerely,
NUTTING ENGINEERS OF FLORIDA, INC.

7/30/14

Paul C. Catledge, P.E. #68448
Senior Engineer

Attachments: Boring Location Plan
Test Boring Reports (1-3)
Exfiltration Test Results (1-3)
Soil Classification Criteria
Limitations of Liability

NUTTING ENGINEERS OF FLORIDA, INC.
ESTABLISHED 1967

CITY OF HALLANDALE BEACH
MAIN FIRE STATION
NW 5TH ST & NW 1ST AVE.
HALLANDALE BEACH, FLORIDA

APPROXIMATE TEST LOCATIONS

NOT TO SCALE

FIGURE 1

Nutting Engineers of Florida, Inc. | Established 1967
Your Project is Our Commitment
1310 Neptune Drive
Boynton Beach, FL 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-1

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

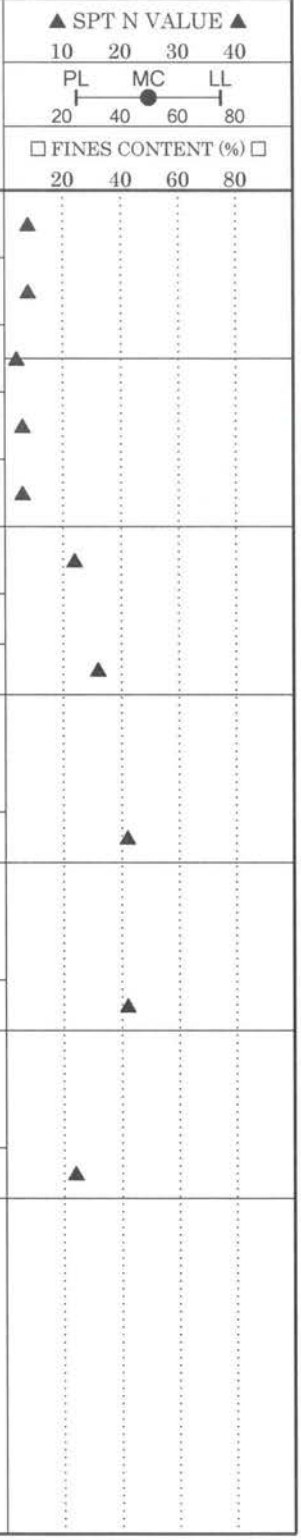
DATE STARTED 7/10/14 COMPLETED 7/10/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ∇ AT TIME OF DRILLING 5.5 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	1-2-2-3	**4**
			2	3-2-2-2	**4**
		Brown quartz fine SAND			
5		∇	3	1-1-1-1	**2**
		Tan quartz fine SAND, some limestone fragments	4	1-1-2-2	**3**
			5	1-1-2-4	**3**
10		Lt. brown quartz fine SAND	6	2-5-7-10	**12**
15			7	6-8-8	**16**
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS			
20			8	8-10-11	**21**
25			9	7-9-12	**21**
30			10	6-6-6	**12**
		Bottom of hole at 30.0 feet.			



TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

Disclaimer Nutting Engineers of Florida, Inc. accepts no liability for the consequences of the independent interpretation of drilling logs by others.

Nutting Engineers of Florida, Inc. | Established 1967
Your Project is Our Commitment
1310 Neptune Drive
Boynton Beach, FL 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-2

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

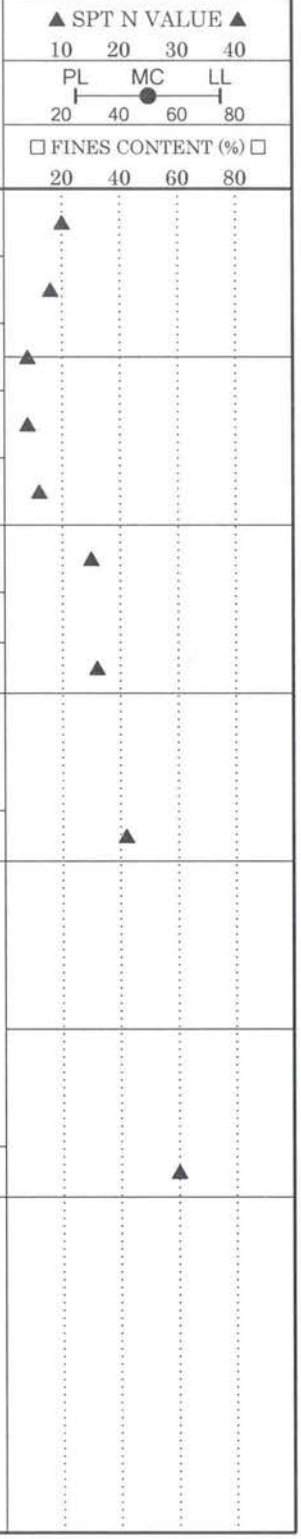
DATE STARTED 7/7/14 COMPLETED 7/7/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ∇ AT TIME OF DRILLING 7.0 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	4-5-5-5	**10**
			2	4-4-4-3	**8**
5		Dk. brown quartz fine SAND	3	1-2-2-2	**4**
		Brown quartz fine SAND			
		∇ Lt. brown quartz fine SAND	4	1-2-2-3	**4**
			5	2-3-3-4	**6**
10					
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS	6	6-7-8-10	**15**
15			7	7-7-9	**16**
20			8	6-12-9	**21**
25					
30			9	7-10-20	**30**
		Bottom of hole at 30.0 feet.			



TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

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BORING NUMBER B-3

PROJECT NUMBER 213.13

CLIENT City of Hallandale Beach **PROJECT NAME** City of Hallandale Beach-Main Fire Station

PROJECT LOCATION NW 5th Street and NW 4th Street, Hallandale Beach, FL 33009

DATE STARTED 7/10/14 COMPLETED 7/10/14 SURFACE ELEVATION REFERENCE Approx. 1' below road crown

DRILLING METHOD Standard Penetration Boring GROUND WATER LEVELS:

LOGGED BY D. Tyson CHECKED BY C. Gworek ▽ AT TIME OF DRILLING 5.5 ft ft

APPROXIMATE LOCATION OF BORING **As located on site plan**

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		Gray quartz fine SAND			
		Lt. tan quartz fine SAND	1	1-2-2-3	**4**
			2	2-3-3-3	**6**
5		▽	3	2-1-1-1	**2**
		Dk. brown quartz fine SAND			
		Brown quartz fine SAND	4	1-1-2-2	**3**
		Lt. tan slightly silty quartz fine SAND and LIMESTONE FRAGMENTS	5	5-6-6-7	**12**
10			6	6-7-7-9	**14**
15			7	6-7-7	**14**
20			8	6-7-9	**16**
25			9	7-14-10	**24**
30			10	6-8-12	**20**
		Bottom of hole at 30.0 feet.			

▲ SPT N VALUE ▲ 10 20 30 40

PL MC LL 20 40 60 80

□ FINES CONTENT (%) □ 20 40 60 80

TEST NUTTING BOREHOLE 2-213.13 CITY OF HALLANDALE BEACH - MAIN FIRE STATION.GPJ GINT US.GDT 7/16/14

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	1
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-5'	Lt. tan quartz fine SAND
5'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	3.2
2	3.1
3	3.0
4	3.0
5	3.0
6	3.0
7	3.0
8	3.0
9	3.0
10	3.0

$K = 2.27 \times 10^{-4}$ cfs/ft^{2}ft.head

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	2
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-4'	Lt. tan quartz fine SAND
4'-5'	Dk. brown quartz fine SAND
5'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	16.4
2	16.3
3	16.0
4	16.0
5	16.0
6	16.0
7	16.0
8	16.0
9	16.0
10	16.0

$K = 1.21 \times 10^{-3}$ cfs/ft^{2}ft.head

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Report of Exfiltration Test

Client:	City of Hallandale Beach	Order No	213.13
Project:	City of Hallandale Beach-Main Fire Station	Report No	3
Location:	NW 5th St. and NW 4th St. between NW 1st Ave and NW 2nd Ave Hallandale Beach, FL	Date:	7/7/14
Test:	Usual Open Hole Exfiltration Test		
Surface Elevation:	Approx. Same as Road Crown	Water table from ground surface:	6'
Casing Diameter:	6"		
Tube Depth:	6'		

Sample Location: Approx. as located on site plan

Material:

0'-0.5'	Gray quartz fine SAND
0.5'-4'	Lt. tan quartz fine SAND
4'-6'	Brown quartz fine SAND

One Minute Increment	Pump Rate in Gal/Min
1	4.3
2	4.3
3	4.2
4	4.2
5	4.2
6	4.2
7	4.2
8	4.2
9	4.2
10	4.2

$K = 3.18 \times 10^{-4}$ cfs/ft^{2}ft.head

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SOIL AND ROCK CLASSIFICATION CRITERIA

SAND/SILT

N-VALUE (bpf)	RELATIVE DENSITY
0 – 4	Very Loose
5 – 10	Loose
11 – 29	Medium
30 – 49	Dense
>50	Very dense
100	Refusal

CLAY/SILTY CLAY

N-VALUE (bpf)	UNCONFINED COMP. STRENGTH (tsf)	CONSISTENCY
<2	<0.25	v. Soft
2 – 4	0.25 – 0.50	Soft
5 – 8	0.50 – 1.00	Medium
9 – 15	1.00 – 2.00	Soft
16 – 30	2.00 – 4.00	v. Stiff
>30	>4.00	Hard

ROCK

N-VALUE (bpf)	RELATIVE HARDNESS	ROCK CHARACTERISTICS
N≥ 100	Hard to v. hard	Local rock formations vary in hardness from soft to very hard within short vertical and horizontal distances and often contain vertical solution holes of 3 to 36 inch diameter to varying depths and horizontal solution features. Rock may be brittle to split spoon impact, but more resistant to excavation.
25≤ N ≤ 100	Medium hard to hard	
5≤ N ≤ 25	Soft to medium hard	

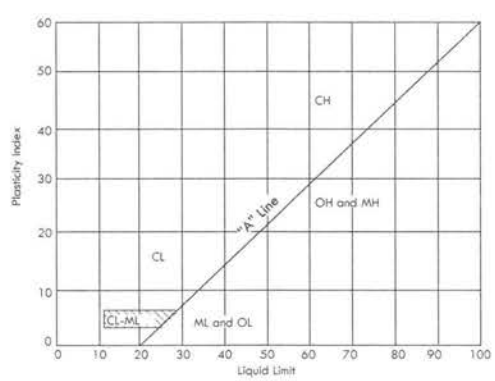
PARTICLE SIZE

Boulder	>12 in.
Cobble	3 to 12 in.
Gravel	4.76 mm to 3 in.
Sand	0.074 mm to 4.76 mm
Silt	0.005 mm to 0.074 mm
Clay	<0.005 mm

DESCRIPTION MODIFIERS

0 – 5%	Slight trace
6 – 10%	Trace
11 – 20%	Little
21 – 35%	Some
>35%	And

Major Divisions			Group Symbols	Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gavels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than five percent.....GW, GP, SW, SP; More than 12 percent.....GM, GC, SM, SC; 5 to 12 percent.....Borderline cases requiring dual systems**	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GW* d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
						Atterberg limits above "A" line with P.I. greater than 7	
			GC	Clayey gravels, gravel-sand-clay mixtures			
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM* d / u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual system.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. more than 7	
Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy, clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays or high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		PT	Peat and other highly organic soils			



Plasticity Chart

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LIMITATIONS OF LIABLILITY

WARRANTY

We warranty that the services performed by Nutting Engineers of Florida, Inc. are conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession in our area currently practicing under similar conditions at the time our services were performed. ***No other warranties, expressed or implied, are made***. While the services of Nutting Engineers of Florida, Inc. are a valuable and integral part of the design and construction teams, we do not warrant, guarantee or insure the quality, completeness, or satisfactory performance of designs, construction plans, specifications we have not prepared, nor the ultimate performance of building site materials or assembly/construction.

SUBSURFACE EXPLORATION

Subsurface exploration is normally accomplished by test borings; test pits are sometimes employed. The method of determining the boring location and the surface elevation at the boring is noted in the report. This information is represented in the soil boring logs and/or a drawing. The location and elevation of the borings should be considered accurate only to the degree inherent with the method used and may be approximate.

The soil boring log includes sampling information, description of the materials recovered, approximate depths of boundaries between soil and rock strata as encountered and immediate depth to water data. The log represents conditions recorded specifically at the location where and when the boring was made. Site conditions may vary through time as will subsurface conditions. The boundaries between different soil strata as encountered are indicated at specific depths; however, these depths are in fact approximate and dependent upon the frequency of sampling, nature and consistency of the respective strata. Substantial variation between soil borings may commonly exist in subsurface conditions. Water level readings are made at the time and under conditions stated on the boring logs. Water levels change with time, precipitation, canal level, local well drawdown and other factors. Water level data provided on soil boring logs shall not be relied upon for groundwater based design or construction considerations.

LABORATORY AND FIELD TESTS

Tests are performed in *general* accordance with specific ASTM Standards unless otherwise indicated. All criteria included in a given ASTM Standard are not always required and performed. Each test boring report indicates the measurements and data developed at each specific test location.

ANALYSIS AND RECOMMENDATIONS

The geotechnical report is prepared primarily to aid in the design of site work and structural foundations. Although the information in the report is expected to be sufficient for these purposes, it shall not be utilized to determine the cost of construction nor to stand alone as a construction specification. Contractors shall verify subsurface conditions as may be appropriate prior to undertaking subsurface work.

Report recommendations are based primarily on data from test borings made at the locations shown on the test boring reports. Soil variations commonly exist between boring locations. Such variations may not become evident until construction. Test pits sometimes provide valuable supplemental information that derived from soil borings. If variations are then noted, the geotechnical engineer shall be contacted in writing immediately so that field conditions can be examined and recommendations revised if necessary.

The geotechnical report states our understanding as to the location, dimensions and structural features proposed for the site. ***Any significant changes of the site improvements or site conditions must be communicated in writing to the geotechnical engineer immediately*** so that the geotechnical analysis, conclusions, and recommendations can be reviewed and appropriately adjusted as necessary.

CONSTRUCTION OBSERVATION

Construction observation and testing is an important element of geotechnical services. The geotechnical engineer's field representative (G.E.F.R.) is the "owner's representative" observing the work of the contractor, performing tests and reporting data from such tests and observations. ***The geotechnical engineer's field representative does not direct the contractor's construction means, methods, operations or personnel.*** The G.E.F.R. does not interfere with the relationship between the owner and the contractor and, except as an observer, does not become a substitute owner on site. The G.E.F.R. is responsible for his/her safety, but has no responsibility for the safety of other personnel at the site. The G.E.F.R. is an important member of a team whose responsibility is to observe and test the work being done and report to the owner whether that work is being carried out in general conformance with the plans and specifications. The enclosed report may be relied upon solely by the named client.

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and Division 1 specification sections, apply to this section.

1.2 RELATED SECTIONS

A. Section 018113 – LEED Submittal Requirements

B. Section 033300 – Architectural Concrete

1.3 DESCRIPTION

A. SCOPE OF WORK

1. Provide all labor, materials, equipment and services necessary to complete all cast-in-place concrete work, including formwork, reinforcing steel and all related work as shown and specified, except as specifically excluded hereinafter.
2. In addition to construction of cast-in-place concrete work, the work includes the items listed below:
   a. Setting anchor bolts, frames, and other items indicated to be embedded in concrete
   b. Grouting of structural steel bearing on concrete
   c. Concrete curbs
   d. Dowels for masonry walls
   e. Concrete walks
   f. Concrete pavement
   g. Laboratory field testing services
3. Cooperate with affected personnel or contractors in setting and/or fastening sleeves, piping, inserts, conduits, hangers, ties and similar items in the forms, where such items are to be furnished and installed under other subdivisions of these specifications.

B. RELATED WORK NOT SPECIFIED UNDER THIS SUBDIVISION

1. Foundations and pads not shown on architectural, civil or structural drawings.
2. Furnishing steel frames and grating.
3. Furnishing miscellaneous steel shapes and plates embedded in concrete.
4. Furnishing anchor bolts for structural steel.
5. Furnishing piping and conduit embedded in concrete.

1.4 QUALITY ASSURANCE

A. APPLICABLE STANDARDS

1. Provide all materials and perform all work in accordance with the latest issue of ACI 301 "Standard Specifications for Structural Concrete A“ and the reference specifications listed therein.

2. The applicable provisions of the latest issue of the following ACI and CRSI Standards are made a part of these specifications. Where the provisions of any reference specification conflict with those of ACI 301, the more stringent provisions govern.

ACI NUMBER	TITLE
302.1R	Guide for Concrete Floor and Slab Construction
304.R	Guide for Measuring, Mixing, Transporting and Placing Concrete
304.2R	Placing concrete by pumping methods.
305R	Hot Weather Concreting
306R	Cold Weather Concreting
308	Standard Practice for Curing Concrete
309R	Guide for Consolidation of Concrete
315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
318	Building code requirements for reinforced concrete
347	Recommended Practice for Concrete Formwork
70-56	Guide for Use of Epoxy Compounds with Concrete – Committee 503 Report
75-18	Concrete committee 503 report. Cold weather concreting.

CRSI NUMBER	TITLE
63	Recommended Practice for Placing Reinforcing Bars

1.5 SUBMITTALS

A. Submit, not less than 21 days prior to placing of concrete, the following proposed concrete mix design data:

1. Intended usage and location for each type
2. Mix design for each type
3. Cement content in pounds per cubic yard
4. Coarse and fine aggregate in pounds per cubic yard
5. Water-cement ratio by weight
6. Cement type and manufacturer
7. Slump range
8. Air content range
9. Admixture types and manufacturers
10. Percent of admixtures by weight
11. Strength test data required to establish mix design

B. Submit complete detail and placing shop drawings for all reinforcing steel including accessories that have been reviewed and stamped by the General Contractor.

C. LEED SUBMITTALS

1. Coordinate the required extent of each relevant construction phase credit.

2. Refer to the appropriate LEED version and rating system reference as dictated by the LEED project administrator.

3. Materials Resources:

a. MR-c4 (recycled content) - submit manufacturer's product data with information including complete recycled content including pre-consumer and post-consumer content percentages.

b. MR-c5 (regional materials) - submit manufacturer's product data with information including location of extraction, harvesting, and manufacturing miles from project.

c. MR-c7 (certified wood) – submit product data with information including quantities and chain of custody certification.

4. Indoor Environmental Quality:

a. EQ-c4.1 & EQ-c4.2 (low emitting materials) - submit manufacturer's product data with information including the voc levels of each product.

D. Refer to Section 01350 for all submittals.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement - ASTM C 150, Type I. Type III may be used where authorized by the Engineer.

B. Air-Entraining Admixtures - ASTM C 260, Darax AEA, W. R. Grace & Company, SIKA AER, SIKA, MB-AE90, Master Builders, Air Mix, Euclid Chemical Corp.

C. Water-Reducing Admixtures - ASTM C 494, Type D. WRDA-64, W.R. Grace & Company Plastiment, SIKA, Pozzolith N, Master Builders.

D. No accelerators, retarders or admixtures containing chlorides will be permitted.

E. Use fresh, clean and drinkable water for concrete.

F. For normal weight concrete use coarse and fine aggregate to conform to ASTM C33.

G. Super Plasticizer ASTM C494 Type F or G where authorized by the Engineer.

H. Fly-ash ASTM C618 Type C618. Maximum loss on ignition shall not exceed 3% by weight. The combined weight of fly-ash shall not exceed 20 percent of the total weight of cementitious material. The fly-ash present in blended cement conforming to ASTM C595 shall be included in the calculated percentage. Do not use for architectural concrete.

I. Ground granulated blast-furnish slag ASTM C989. The combined weight of GGBFS shall not exceed 50 percent of the total weight of cementitious material. Slag used in blended hydraulic cement confirming to ASTM C595 shall be included in the calculated percentage.

2.2 PROPORTIONING

A. Concrete Strength – See structural drawings for minimum concrete compressive strength at 28 days.

B. PROPERTIES

1. Provide concrete having the general properties specified for each class of concrete with the following tables to provide workability and consistency so concrete can be worked readily into forms and around reinforcement without segregation or bleeding, and to provide an average compressive strength adequate to meet acceptance requirements of ACI 301.

2.3 PRODUCTION OF CONCRETE

A. Concrete must be batched, mixed and transported in accordance with specifications for ready-mixed concrete ASTM C 94.

B. Concrete shall be batched to produce a slump of 4" plus/minus 1". Refer to 2.02B unless noted otherwise.

C. Provide at the site, delivery tickets for each batch of concrete showing the following:
1. Batch number, volume and date
2. Time of loading
3. Design 28-day compressive strength
4. Concrete type
5. Cement content in pounds per cubic yard
6. Water content in pounds per cubic yard
7. Admixtures in amount per cubic yard
8. Maximum amount of water that may be added at the job site.

D. Restrict the addition of mix water at the job site. Do not add water without the approval of the general contractor and do not exceed slump limitations or total allowable water to cement ratio. Use cold water from the truck tank and remix to achieve consistency. The reports shall indicate how much water was added at the job site. Note on delivery ticket amount of water added and name of person authorizing.

E. During hot weather, conform to the detailed recommendations of ACI 305.

F. When air temperature is between 85 and 90 degrees F., reduce mixing and delivery time to 75 minutes. When air temperature is higher than 90 degrees, reduce mixing and delivery time to 60 minutes.

G. Concrete should be deposited as nearly as practicable to its final position to avoid segregation of materials due to re-handling or flowing.

H. Concreting should be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.

I. The use of the following is prohibited:
   1. Partially hardened concrete
   2. Contaminated concrete
   3. Re-tempered concrete
   4. Concrete that has been re-mixed after it has taken its initial set.

J. After concreting has been started, it should be carried on as a continuous operation until placing of a panel or section, as determined by its boundaries or joints, is completed.

K. All concrete should be thoroughly consolidated by suitable means during placement and should be worked around reinforcement and embedded fixtures and into corners of forms.

2.4 PLACING CONCRETE

A. GENERAL

1. Inner surfaces of conveying equipment must be free of hardened concrete and foreign materials.
2. All reinforcing bars are to be tied in proper position prior to placing concrete.
3. Provide sufficient time for inspection of all preparatory work before proceeding with the placing of concrete.
4. Immediately prior to placing concrete, sprinkle semi-porous sub-grades sufficiently to eliminate suction and seal porous sub-grades, except where a vapor barrier is used.
5. Deposit concrete in forms in horizontal layers continuously, no deeper than 18 inches. Horizontal cold joints will not be permitted. Fill forms completely using methods to ensure even distribution of aggregate around reinforcement and into corners of forms.
6. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time to 75 minutes. When air temperature is higher than 90 degrees F, reduce mixing and delivery time to 60 minutes.
7. Concrete shall have a wet cure time of 7 days minimum at 50 degrees minimum temperature.
8. Concrete shall be deposited as nearly as practicable to its final position to avoid segregation of materials due to re-handling or flowing.
9. Concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.
10. The following conditions are prohibited:
    a. Partially hardened concrete.
    b. Contaminated concrete.

c. Re-tempered concrete.
d. Concrete that has been re-mixed after it has taken its initial set.

11. After concreting has been started, it shall be carried on as a continuous operation until placing or a panel or section, as determined by its boundaries or joints, is completed.

B. CONSOLIDATION

1. Consolidate concrete by vibration in accordance with the detailed recommendations of ACI 309.
2. Internal vibrators must be used in beams, girders and framed slabs and along bulkheads or slabs-on-grade to thoroughly consolidate the concrete. Do not use grossly oversized equipment.
3. Do not use vibrators to transport concrete within forms.

C. FINISHING

1. Finish concrete slabs in accordance with the finishes and tolerances as specified in ACI 301, and the detailed recommendations in ACI 302. Confirm all finishes with Architect.
2. Dusting of slabs with cement or other materials to absorb excess bleed water is strictly prohibited.

ITEM	TOLERANCE CLASS	FINISH
Exterior Pavement	B	Broom or belt
Exterior Walks/Curbs	B	Fine broom
Interior Slabs	A	Troweled
Exterior Steps	A	Nonslip

3. For flat, very flat and super flat floors, "F" numbers are required for defining flatness and levelness. Refer to ACI 301.1R, Fig. 8.15.1.1, for minimum required "F" numbers for type of slab use.

D. NONSLIP FINISH

1. Give surface a dry shake application as specified in ACI 301 using crushed selected abrasive aggregate of aluminum oxide. The rate of application of blended mixture should not be less than 25 pounds per 100 square feet of surface.
2. Acceptable products are:

TYPE	MANUFACTURER
Grip-It	L&M Construction Chemicals
Frictex N.S.	Sonneborn
Nonslip	Euclid Chemical Co.
Emag 20	Lambert Corp.

2.5 REINFORCEMENT

A. GENERAL

1. Details of concrete reinforcement and accessories not covered herein or shown on drawings to be in accordance with ACI 315.

2. Reinforcement is to be secured in proper position and thoroughly clean of loose rust, scale, grease or other coatings.

3. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. REINFORCING MATERIALS

1. Unless otherwise indicated, for all reinforcing shown provide deformed bars conforming to ASTM A 615, or a 616 Grade 60.
2. Smooth dowels - ASTM A 615 and A 616, plain bars having a minimum yield strength of 60,000 psi.
3. Welded wire fabric - ASTM A 185 plain wire fabric in flat sheets.
4. Plain wire to conform to ASTM A 82.
5. Accessories to conform to ACI 315.
6. Where reinforcing rods are used as supports, use rods no lighter than No. 5.
7. Where concrete surfaces are exposed, make those portions of all accessories in contact with the concrete surface or within 1/2 inch thereof, of plastic or stainless steel.
8. Reinforcing steel should be free of kinks and non-shop bends. Field bends should be only as approved by the architect.

C. FIBROUS REINFORCING (Synthetic)

1. Reinforcing fibers to be virgin 100% polypropylene fibers, per ASTM C1116, specifically manufactured for use in concrete, containing no reprocessed olefin materials, with the following minimum physical characteristics:
   a. specific gravity: 0.91
   b. modulus of elasticity: 500-700 KSI
   c. tensile strength: 70-110 KSI
   d. fiber length: multi-design gradation, 3/4" maximum.
2. Reinforcing fibers to be supplied by the following approved manufacturers:
   a. "FIBERSTRAND 100", Euclid Chemical Company
   b. "FIBERMESH INFORCE e^3 or STEALTH $e^{3"}$, SI Concrete Systems
   c. "FORTA SUPER-NET", Forta Corporation
   d. "NYCON FIBERS", Nycon, Inc.
3. Fibers to be added in manufacturer's approved amount with a minimum of 1.5 pounds per cubic yard for poly and 1.0 pounds per cubic yard for nylon.
4. Concrete to be batched and mixed in accordance with fiber manufacturer's recommendations for uniform and complete dispersion of fiber bundles into single strands within concrete.
5. Reinforcing fibers may be used in concrete slabs-on-grade in lieu of WWF with approval of the engineer.
6. Submit product data for review and approval.
7. For a "non-hairy" surface use a monofilament fiber. Collated fibrillated fibers wear away in a short period of time.

D. FIBROUS REINFORCING (alternate to wwf on composite metal decks)

1. All fibers must meet the criteria in the Steel Deck Institute design manual (Publication No. 30).
2. Cold drawn steel fibers meeting the criteria of ASTM A820, at a minimum addition rate of 25 lb/yd3 (14.8 kg/m3) and possessing an average residual strength of at least 80 psi 550 kpa when tested ASTM C1399, may be used as a suitable alternative to the welded wire fabric specified for temperature and shrinkage reinforcement.
3. Reinforcing fiber to be supplied by the following approved suppliers:
   a. "NOVOMESH 850, or NOVOCON 1050" by SI Concrete Systems
   b. "DRAMIX 65/60" by Bekaert
4. Steel fibers do not replace rebar over girders, which are used to control negative moment.
5. Steel fibers are to be added at the batch plant and in accordance with the manufacturer's recommendations for uniform and complete dispersion.

PART 3 - EXECUTION

3.1 PLACING

A. GENERAL

1. Place reinforcing in conformance with the requirements of CRSI 63. Place reinforcement in proper position prior to placing concrete. Placing reinforcement during concrete placement will not be permitted.
2. Unless otherwise shown or indicated, provide minimum concrete protective covering for reinforcement as follows:
   a. Concrete deposited against the ground, 3".
   b. Formed surfaces exposed to weather or in contact with the ground, 2" for reinforcing bars No. 6 or larger, and 1-1/2" for reinforcing bars No. 5 or smaller.
   c. Interior surfaces, 1-1/2" for beams, girders and columns, 3/4" for slabs, walls and joists.
   d. See drawing for special conditions.
3. Support reinforcing for slabs-on-grade on staggered concrete bricks or metal or plastic bar chairs and spacers with metal plates.
4. Unless specifically authorized, do not bend reinforcement partially embedded in hardened concrete.
5. Support and fasten all dowels in the formwork prior to placing concrete. Do not place dowels after concrete is in place.

3.2 JOINTS

A. CONSTRUCTION JOINTS

1. Construction joints not shown in the contract documents must be located and made to least impair the strength of the structure.
2. No horizontal construction joints will be permitted in beams, girders or slabs.

3. Location of any construction joint not shown is subject to review and acceptance by Engineer.
4. Reinforcing is continuous through all construction joints. Obtain bond by roughening surface of concrete in an acceptable manner which will expose aggregate uniformly and will not leave any latence, loosened particles or aggregate or damaged concrete at surface.
5. Construction joints shall be cleaned, wetted, and standing water removed.
6. All concrete shall be thoroughly consolidated by suitable means during placement and should be worked around reinforcement and embedded fixtures and into corners of forms.
7. Concrete wet cure time to be 7 days minimum at 50 degrees minimum temperature.

B. EXPANSION JOINTS

1. Reinforcement or other embedded metal items bonded to the concrete (except dowels in floors bonded on only one side of joints) will not be permitted to extend continuously through any expansion joint.

C. DOWELED SLIP JOINTS

1. Use completely smooth round bars for dowels.
2. For construction joints, paint half of bar with red lead paint. When dry, coat painted end with satisfactory grease to insure against bond with concrete.
3. For control joints, paint and grease entire bar.
4. For expansion joints, paint, grease and provide a metal expansion cap for one end.
5. Place in forms to insure that bars are perpendicular to joint face. Stop reinforcement at doweled slip joints so that it will not extend through joint.

D. JOINT MATERIALS

1. Expansion joint filler non-bituminous type - ASTM D 1752, resin impregnated fiberboard Homosote 300 or Thermosetting Polyurethane, W. R. Meadows' Rescor. Asphalt impregnated materials are unacceptable.
2. Polyethylene Film - ASTM D 2103 minimum 6 mil.
3. Horizontal Joint Sealer - 2-component self-leveling urethane conforming to Federal Specification TT-S-227E, Type 1, Class A. Color to match concrete. Acceptable products are :

TYPE	MANUFACTURER
Daraseal-U	A. C. Horn
Sonolastic SL2	Sonneborn
Pourthane	W. R. Meadows

4. Vertical Joint Sealer - 1-component Polyurethane conforming to Federal Specification TT-S-002306, Type II, Class A, color to match concrete.

   Acceptable products are:

TYPE	MANUFACTURER
SIKAFLEX IA	SIKA
SONOLASTIC NPI	Sonneborn

5. Epoxy Joint Sealer - semi-rigid epoxy, MM80 as manufactured by Metzger McGuire Co., master fill 300 by Master Builders.

6. Epoxy Bond - 2-component 100 percent solids epoxy resin, amine cured. Acceptable materials are Concresive Series by Master Builders, Sonneborn=s Epogrip and Epiweld 580 by Lambert Corp.
7. Epoxy Grout - Epoxy bond filled with suitable mineral filler, 100 percent passing the No. 100 sieve, in ratio to insure thixotropic action without impairment of adhesive properties.
8. Compressive Joint Material - expanded polystyrene having a compressive strength not less than 8 psi when the board is compressed to a deformation of 5 percent of its original thickness when tested in conformance with ASTM C 165, modified to change drying temperature to 150ºF.
9. Felt - 30 pound asphalt or coal tar roofing felt ASTM D 226 or D 227.

E. PLACING DOWELS IN EXISTING CONCRETE

1. Use deformed reinforcing bars as dowels. Drill holes in existing concrete of size 1/2" larger in diameter than the dowel using power-driven drill with tungsten-carbide tipped bit ground to insure against oversize hole. Clean out holes with air
Thoroughly swab surfaces of hole and embedded portion of dowel with epoxy grout. Force dowel into place. Wipe off excess grout and let set for not less than 12 hours at a temperature above 60ºF.

3.3 FORMWORK

A. GENERAL

1. Provide and construct formwork in accordance with ACI 301 and 347.
2. Form design by P.E. registered in the State of Florida.
3. Observe and check formwork continuously while concrete is being placed to determine that there are no evidences of changes of elevations, plumbness, or camber and adjust forms as necessary. If, during construction, any such evidence or other defect appears, stop the work, remove concrete placed, if necessary, and repair formwork or supports before proceeding.
4. Earth cuts may be used as forms for footing vertical surfaces increase size 2 inch.
5. Forms and shoring is the responsibility of General Contractor.

B. FORMWORK MATERIALS

1. Make forms of lumber, plywood, metal or other materials suitable to provide the strength and tolerances specified herein before and the surface finishes specified hereinafter.
2. Forming exposed surfaces use any of the following materials as suitable for the specified finish, and to produce smooth uniform surfaces, true-to-line, in order that surfaces produced will require little finishing:
   a. New plastic-bonded natural plywood, American Plywood Association, HD Overlay Plyform Class I, Ext-APA, or equal.

3. For forming exposed surfaces use plywood, or other nonmetallic surfaces free from knots, warps, breaks, or other defects likely to cause irregular surfaces.
4. Provide commercial formulation form coating compounds with maximum VOC of 350 mg/1 that will not bond with stain or adversely affect concrete surfaces and will not impair subsequent surface treatments.

C. REMOVAL OF FORMS

1. Forms and shoring in the formwork supporting the weight of concrete, in beams, slabs and other structural elements are to remain in place until the concrete has reached its specified 28-day compressive strength.
2. Formwork and facing forms for members such as grade beams, foundation walls and spread footings not supporting the weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from the removal operations.
3. Arrange shores and other vertical supports so that the non-load carrying form-facing material may be removed without loosening or disturbing the shores and supports.
4. Whenever the formwork is removed during the curing period, continue curing of both the unexposed and exposed concrete by one of the methods specified in section "Curing and Protection".

D. REMOVAL STRENGTH

1. Removal Strength - The concrete will be presumed to have reached its specified strength when additional test cylinders (paid for by contractor) are field cured along with the concrete they represent and have reached the strength specified.

3.4 REPAIR OF SURFACE DEFECTS

A. GENERAL

1. Patch all tie holes and repair all honeycombed and defective areas immediately after form removal.
2. For surfaces other than those to be backfilled against, use patching mortar.
3. For surfaces to be backfilled against, use mastic damp-proofing compound, except that where reinforcing is exposed, use patching mortar.
4. Remove all honeycombed and defective concrete down to sound concrete prior to patching. Thoroughly clean the holes of dirt and debris.

B. PATCHING MORTAR

1. Cut edges of honeycombed and defective concrete to form dove-tail (undercut) joints. No feather edges will be permitted.
2. Apply a chemical bonding agent to voided surface. An acceptable product is L&M Construction chemicals – Everbond or equivalent.
3. Patch the cement mortar as specified in ACI 301, or with proprietary patching compounds, except that proprietary patching mixtures may be not used on exposed surfaces.
4. Acceptable proprietary patching mixtures are:
   a. Euclid Chemical Corporation - Poly Patch
   b. SIKA - Sikaset Mortar
   c. Emaco R Series - Master Builders
   d. Lambert Corp, Lambco Vinyl Patch
   e. Sonneborn - Sonopatch

C. MASTIC DAMP-PROOFING COMPOUND

1. Patch full depth of hole and flush the surface with emulsified asphalt mastic heavy viscosity for trowel application. Prepare and place in accordance with manufacturer's directions. Acceptable products are:
   a. W. R. Meadows - Sealmastic Trowel Mastic
   b. Euclid Chemical Company - Damp-proofing Asphalt Coatings
   c. Sonneborn - Hydrocide 700 Mastic
   d. Lambert Corp – Waterban 60M

3.5 FINISHING OF FORMED SURFACES - GENERAL

A. After removal of forms, give surfaces of concrete the following finishes as specified in ACI 301.

SURFACE	FINISH
Unexposed	Rough Form
Exposed	Smooth Form
Exposed to Public View	Smooth Rubbed

3.6 CURING AND PROTECTION

A. GENERAL

1. Conform to the applicable detailed recommendations of ACI 301 and 308.
2. Hot weather curing to be in accordance with applicable ACI Standard 305.
3. All cast-in-place concrete must be maintained with minimal moisture loss at a relatively constant temperature for a minimum of 7 days following the placing of the concrete by the use of a water spray, water saturated fabric, moisture retaining membrane or liquid curing compound.
4. Full curing days will be determined by the cumulative number of days or fractions thereof during which the temperature of the air in contact with the concrete is above 50°F.
5. Cure slabs-on-grade for the first 72 hours by the use of:
   a. fog spraying
   b. ponding
   c. sprinkling
   d. continuously wet absorptive mats or fabric
   e. continue curing by use of moisture retaining cover until
   concrete has obtained its specified 28 day compressive strength
   f. or liquid curing compound after finishing process is completed.
   g. concrete wet cure time to be 7 days minimum at 50 degrees minimum temperature.
6. Submit materials and method of curing for review.
7. Do not use moisture retaining curing compounds for curing surfaces to receive the following coverings, unless it has been demonstrated that such compounds will not prevent bond of:
   a. Carpet
   b. Flexible flooring
   c. Ceramic tiled floors
   d. Other specified floor systems

B. MATERIALS

1. Where moisture retaining membranes or curing compounds are used for curing, provide only materials conforming to the following requirements:
   a. Polyethylene Film - ASTM C171, Type II
   b. Waterproof Paper - ASTM C 171, Type I
   c. Absorptive Cover - AASHTO M 182, Class 3, Burlap cloth made from Jute or Kenaf or ASTM C 440 cotton mats
   d. ASTM C309 spray on at max.

C. TEMPERATURE, WIND AND HUMIDITY

1. Do not permit concrete not fully cured to be exposed to excessive temperature changes or high winds.

3.7 EMBEDDED ITEMS

A. GENERAL

1. Prior to concreting, place all embedded items to be provided under this subdivision or to be furnished under other subdivisions for installation under this subdivision.
2. Give all contractors whose work is related to the concrete or must be supported by it, ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
3. Make certain that all embedded items furnished and set in forms by them are secured in position, and exercise due care not to disturb or damage their work while placing concrete.
4. Set anchor bolts for steel and equipment in accordance with setting drawings or templates which have been reviewed and found satisfactory.
5. Where holes in concrete for such purposes as recesses for railing posts, passageways for pipes, and the like are shown formed by sleeves, the contractor may, at his option, provide such holes by drilling with a acceptable diamond or tungsten carbide tipped drill bits. Fill with epoxy seal after railings are in place.

B. EMBEDDED ITEMS TO BE PROVIDED UNDER THIS SUBDIVISION

1. Dovetail anchor slots and dovetail brick anchors - DAS-G20 beehive dovetail anchor slot as manufactured by Gateway Building Products, together with DBA-G14 dovetail brick anchors. provide masonry trades with one anchor for each 16" of anchor slot or fraction thereof plus one additional anchor for each vertical
   section. Place anchor slots 1'-4" on center in beams and walls where masonry abuts and one slot in each face of each column faced with masonry. Furnish anchors to space 16" on center in slots.
2. Plastic reglets for above and below grade counter flashing. Make of Type A rigid polyvinyl chloride, 0.060" thick, as manufactured by Superior Concrete Accessories, Inc. or equal.

3. Sleeves - galvanized steel pipe ASTM A 120, or plastic pipe ASTM D 2661, ASTM D 2665 or ASTM D 2852, bituminized fiber pipe conforming to ASTM D 1861 or Wilson anchor bolt sleeve.
4. Column Anchor Bolts - ASTM F 1554. Furnish with one leveling nut plus one nut and one washer.
5. Anchor Bolts – ASTM A 307. As shown on drawings.
6. Cast Iron Frames and Grates - as manufactured by Neenah Foundry Company. Castings as manufactured by Flockhart Foundry Company or McKinley Iron Works may be acceptable, provided the dimensions and design are comparable in all respects.
7. Water stops locations as shown on drawings.

3.8 VAPOR RETARDER

1. Provide sub-grade under concrete slabs-on-grade with vapor retarder consisting of polyethylene film not thinner than 10 mils, conforming to ASTM E1745, or asphalt laminated reinforced Kraft paper with polyethylene coating on both sides. Moistop as manufactured by FortiFiber Building Systems Group.
2. Provide film in width and length not less than one foot larger than dimensions of slab sub-grade unless patently impracticable. Lap edges not less than 6" and tape continuously. Take care to avoid puncturing film. Immediately prior to placing concrete, tape-seal all tears, cuts and holes.

3.9 GROUTING OF BASE PLATES

1. Nonferrous grout acceptable products are:

TYPE	MANUFACTURER
Crystex	L&M Construction Chemicals
Five Star	U.S. Grout
Sonogrout	Sonneborn
Euco N.S.	Euclid Chemical Company
Construction Grout	Master Builders
Vibroprvf #11	Lambert Corp.

2. Mix and place in conformance with printed instructions of the manufacturer.

3.10 TESTING

A. GENERAL

1. The services of an independent testing laboratory shall be retained for obtaining test specimens and performing quality control work, routine testing of materials or proposed mix designs and of resulting concrete for compliance with technical requirements of specifications.
2. Testing of field-cured test cylinders, or testing required because of changes requested by contractor in materials or proportions of the mix, as well as any extra testing of concrete or materials occasioned by failure to meet specification requirements, to be at contractor's expense.

3. Failure of the testing laboratory to detect any defective work or materials is not in any way to prevent later rejection when such defect is discovered, nor is it to obligate the owner for final acceptance.
4. The testing agency and/or its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the specifications, not to approve or accept any portion of the work, not to act as foreman or perform other duties for contractor.

B. SERVICES PROVIDED BY THE TESTING AGENCY

1. Field Sampling - Secure from different batches, on a truly random basis, composite samples for all field testing required below in accordance with ASTM C 172 where applicable. Take all samples at discharge end of conveying system. Clearly mark each test specimen master as to exact part of the structure represented, class of concrete curing conditions, temperature of concrete, and time and date of sample.
2. Compressive Strength Test - mold and cure test cylinders in accordance with ASTM C 31 and test each cylinder for strength in accordance with ASTM C 39. Take one "test set" consisting of four cylinders for each day's pour of 50 cubic yards, or fraction thereof. Test cylinders one at 7 and two 28 days, one hold.
3. Slump Tests - determine slump range for each "test set" in conformance with ASTM C 143.
4. Air Content Test - determine air content for each "test set" for air-entrained concrete in accordance with ASTM C 231.
5. Submit two copies of the results in each of the above tests and inspection to the contractor and the owner's representative and Engineer.
6. Should any of the test results fail to meet the requirements specified, make an immediate telephone report to the contractor and the owner's representative.
7. Furnish evaluation reports of compression tests as recommended by ACI 214 when any compression test fails to meet the specified strength.
8. Criteria for acceptance of concrete cylinder tests:
   a) Every arithmetic average of any consecutive three tests equals or exceed f'c, and
   b) No individual strength test (average of two cylinders) <f'c by more than 500 psi.

3.11 ACCEPTANCE OF STRUCTURE

A. GENERAL

1. Acceptance of structure will be made in conformance with ACI 301, except that contractor must pay all costs incurred for providing any additional testing or analysis required when strength of structure is considered potentially deficient.

B. CRACKS

1. The contractor will be required to restore without cost to the owner any concrete which develops cracks within a period of one year after placement which has not been caused by action of the owner or others in over stressing the concrete.

2. Repair the cracks by means that will restore the cracked members to their designed strength and appearance by acceptable methods which will not impair the appearance of the affected surfaces, if exposed. Such repairs must be performed by use of suitable epoxy cements employed by an organization having satisfactorily demonstrated ability in the techniques necessary to effect such repairs, or by other acceptable methods.

END OF SECTION 033000

SECTION 033060 - DYE STAINED COLORED MECHANICALLY GROUND AND POLISHED CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

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

B. Section Includes:
1. Dye stained concrete interior floor slabs.
2. Densified & Mechanically Polished Dyed concrete.
3. Pigmented Water Based Curing Compound
4. Protective Blankets for finished floor.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical data sheets for the following:
1. Concrete dye stain.
2. Liquid Lithium Silicate Densifier
3. Stain Guard Finish Coat

B. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

C. Qualification Data: For firms indicated in "Quality Assurance" Article, including list of completed projects.

D. Submit the following in accordance with Section 013300 "Submittal Procedures."

E. Product data for each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator, penetrating sealer, and any other chemicals used in the process.

F. Applicators qualification data.

G. Polished concrete samples: Minimum size 7x9 inches, for each Polished Concrete finish required.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with experience in the production of specified products.

B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality.

C. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.

D. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.

E. Pre-installation Conference: Conduct conference at project site to comply with requirements in Section 013100 “Project Management and Coordination.”

F. Provide project names, addresses, contact names, phone numbers of at least three (3) local projects of similar scope completed by the installer within the past five years.

G. Installer/Applicator shall be certified by concrete finish equipment and chemical manufacturer and shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.

H. Manufacturer’s Certification: Provide a letter of acknowledgement from both the equipment and chemical manufacturer stating that the installer is a trained applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.

I. Dye Stained Ground and Polished Concrete Mockups:
   1. Provide under provisions of Division 1 Section 014000 “Quality Control.”
   2. At location on Project selected by Architect, place and finish 10 ft. by 10 ft. area.
   3. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the final work for the Project.
   4. Retain samples of cements, sands, aggregates and color additives used in mockup for comparison with materials used in remaining work.
   5. Aggregate selected must be tested to ensure it will accept polish.
   6. Select from Part 4 – Schedules cut and shine level and finish coat.
   7. Edges should be included in mockup.
   8. Accepted mockup provides visual standard for work of Section.
   9. Mockup shall remain through completion of work for use as a quality standard for finished work.
   10. Remove mockup when directed, or if acceptable to the Architect the mockup may become part of the finished product.

J. Environmental Limitations:
   1. Comply with manufacturer’s written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
   2. Application of finish and dye system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
   3. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions. Deliver dye stain and liquid densifier in original, unopened packaging. Store in dry conditions.

1.5 PRE-JOB CONFERENCE

A. One week prior to polishing of concrete a meeting will be held to discuss the Project and application materials.

B. It is suggested that the Architect, General Contractor, Subcontractor, Ready-Mix Concrete Representative, and a Manufacturer's Representative be present.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. L.M. SCOFIELD COMPANY, Douglasville, Georgia and Los Angeles, California (800) 800-9900 or the appropriate local contact: Eastern Division – 201-672-9050; Western Division – 714-568-1870; Central Division Office – 630-377-5959. Florida Representative, Steve Rissi – 727-515-1849

2.2 MATERIALS

A. Pigmented Water Based Curing Compound

1. Lithochrome Colorwax by L.M. SCOFIELD COMPANY

B. Color Liquid Dye Concentrate, Lithium Silicate Densifier and Finish Coat:

1. SCOFIELD® Formula One™ Liquid Dye Concentrate by L.M. SCOFIELD COMPANY.
2. SCOFIELD® Formula One-MP™ Lithium Densifier by L.M. SCOFIELD COMPANY.
3. SCOFIELD® Formula One™ Guard-W Finish Coat by L.M. SCOFIELD COMPANY.

C. Concrete Grinding & Polishing Equipment:

2. 3-head or 4-head counter rotating variable speed floor grinding machine with at least 600 pounds down pressure.
3. Dust extraction system, pre-separator, and squeegee attachments with minimum flow rating of 322 cubit feet per minute.
4. Grinding heads:
   a. Metal bonded grits. To be determined by condition of concrete slab.
   b. Resin bonded, phenolic diamonds, grits. To be determined by condition of concrete slab.
5. Grinding pads for edges:
   a. 50, 100 and 150 grits metal.
   b. 100, 200, 400, 800, 1500 grits resin.
6. Hand grinder with dust extraction equipment and pads.

D. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:

1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
2. Documented proof that proposed materials have a 5-year proven record of performance, confirmed by at least 3 local recent projects that Architect can examine.

2.3 CONCRETE MIX DESIGN

A. Minimum Cement Content: 5 sacks per cubic yard of concrete.

B. Concrete fines to be natural sand

C. No Air Entraining Admixtures shall be used.

D. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches.

E. Do not add calcium chloride to mix as it causes mottling and surface discoloration.

F. Supplemental admixtures shall not be used unless approved by manufacturer.

G. Do not add water to the mix in the field

2.4 COLORS

A. Concrete Dye Stains:
1. Formula One Liquid Dye Concentrate by L.M. SCOFIELD COMPANY: As selected by the Architect from manufacturer's full color range.

PART 3 – EXECUTION

3.1 CONCRETE INSTALLATION

A. Install concrete according to requirements of Division 3 Section "Cast-In-Place Concrete."

B. Do not add water to concrete mix in the field.

C. Surfaces shall be finished uniformly with the following finish:
1. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.
2. Finish concrete shall have a minimum Floor Flatness rating of at least 50.
3. Finish concrete shall have a minimum Floor Levelness rating of at least 30.
4. Finish concrete shall be cured a minimum of 28 days or at which point equipment can be put on the slab and does not displace aggregate.
5. Ground and Polished Concrete Surface: Precautions should be taken to insure the surface is in tolerances to perform this function.

3.2 WATER BASED PIGMENTED CURING COMPOUND

A. Cure with L.M. SCOFIELD Lithochrome Colorwax water based curing compound.

3.3 MECHANICALLY POLISHED CONCRETE CUT AND SHINE LEVELS

A. Cut Level (Depth of cut)
   2. Grade 2 – light exposure of course aggregate
B. Shine Level
   2. Class 2 – 800 grit polish
C. Polished concrete finish coat
   1. At a distance of 100 feet, the floor will reflect images from side lighting.
   2. Apply two applications of SCOFIELD® Finish Coat.
D. Specified for project
   Grade: II
   Class: III
   Formula One Guard-W applications: 2

3.4 MECHANICALLY POLISHED CONCRETE APPLICATION

A. Applicator shall examine the areas and conditions under which work of this section will be provided and the General Contractor shall correct conditions detrimental to the timely and proper completion of the work and the Applicator shall not proceed until unsatisfactory conditions are resolved.

B. Grind the concrete floor to within 2 – 3 inches of walls with grit as determined by manufactured as appropriate for removing construction debris, floor slab imperfections and until there is a uniform scratch pattern and desired concrete aggregate exposure.

C. Fill construction joints and cracks with filler products as specified in accordance with manufacturer's instructions colored to match with concrete color as specified by architect.

E. Grind & Polish the floor, to 400 grit, first polishing the edges with pads of the same grit and then the field of the floor removing all scratches from the previous grit. After each polish, clean the floor thoroughly using clean water and an auto scrubber or a mop and a wet vacuum.

F. Apply dye to surface at a rate of 400 – 600 square feet per gallon after 400-resin bond grind. Allow dye to dry to touch.

G. After the dye has dried, apply densifier at a rate of 300-400 square feet per gallon. Using a broom, work the material into the floor for a minimum of 30 minutes. Tight squeegee the remaining material from the floor without leaving squeegee marks or puddles. Flush floor with clean water and scrub to remove any excess residue. Allow to cure for 12 – 24 hours undisturbed.

H. Polish to desired gloss level using 800 resin bond grinds.

I. Apply Formula One Guard-W at 1000 square feet per gallon. Allow to dry.

J. Using a high speed (2400 rpm) burnishing machine equipped with 1500 grit diamond impregnated pads, buff the surface to a high shine.

K. Apply second application of Formula One Guard-W at 800 square feet per gallon. Allow to dry.

L. Using a high speed (2400 rpm) burnishing machine equipped with 1500 grit diamond impregnated pads, buff the surface to a high shine.

M. Upon completion, the work shall be ready for final inspection and acceptance by the customer.

3.5 PROTECTION

A. Finished work to be protected with ProGuard Dura Cover Protective Blankets by L.M. SCOFIELD COMPANY

3.6 CLEANING

A. The work area shall be kept clean and free of debris at all times.

B. Remove slurry and dust from adjoining surfaces as necessary.

C. Dispose of material containers in accordance with local regulations.

D. Protect finished work until fully cured per manufacturer's recommendations.

3.6 APPLICATORS

A. For a list of qualified contractors, contact your local Scofield representative or the appropriate Division Office: Eastern Division – 201-672-9050; Western Division – 714-568-1870; Central Division Office – 630-377-5959. Scofield Florida Representative: Steve Rissi – 727-515-1849

END OF SECTION 033060

SECTION 033065 - INTEGRALLY COLORED MECHANICALLY GROUND AND POLISHED CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

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

B. Section Includes:
1. Integrally colored concrete interior floor slabs.
2. Curing of integrally colored concrete.
3. Densified & Mechanically Polished integral colored concrete.

C. Related Sections:
1. Division 3 Section "Cast-In-Place Concrete" for general applications of concrete and coordination of sample submittal and color selection.
2. Division 7 Section "Joint Sealants" for colored sealant for joints.

1.2 REFERENCES

A. American Concrete Institute (ACI):
1. ACI 301 "Specification for Structural Concrete for Buildings."
2. ACI 302 IR "Recommended Practice for Concrete Floor and Slab Construction."
3. ACI 303.1 "Standard Specification for Cast-In-Place Architectural Concrete."
4. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete."
5. ACI 305R "Recommended Practice for Hot Weather Concreting."

B. American Society for Testing and Materials (ASTM):
1. ASTM C309 "Liquid Membrane-Forming Compounds for Curing Concrete."
2. ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
3. ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete.

C. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M194 "Chemical Admixtures."

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical data sheets for the following:
1. Colored admixture.
2. Water Based Pigmented Curing Compound
3. Liquid Lithium Silicate Densifiers
4. Protective Blanket for Polished Concrete Floors

B. Design Mixes: For each type of integrally colored concrete.

C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.

D. Qualification Data: For firms indicated in “Quality Assurance” Article, including list of completed projects.

E. Submit the following in accordance with Division 1, Section 013300 “Submittal Procedures.”

F. Product data for each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator and any other chemicals used in the process.

G. Applicators qualification data.

H. Polished concrete samples: Minimum size 7x9 inches, for each Polished Concrete finish required.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with 10-years experience in the production of specified products.

B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality.

C. Comply with the requirements of ACI 301.

D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.

E. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.

F. Pre-installation Conference: Conduct conference at project site to comply with requirements in Division One, Section 013100 “Project Management and Coordination.”

G. Provide project names, addresses, contact names, phone numbers of at least three (3) projects of similar scope completed by the installer.

H. Installer/Applicator shall be certified by concrete finish equipment and chemical manufacturer and shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.

I. Manufacturer’s Certification: Provide a letter of certification from both the equipment and chemical manufacturer stating that the installer is a certified applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.

J. Integrally Colored Ground and Polished Concrete Mockups.
   1. Provide under provisions of Division 1 Section 014000 “Quality Control.”
   2. At location on Project selected by Architect place and finish 10 ft. by 10 ft. area.

3. For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Excess material shall be discarded according to local regulations.
4. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
5. Retain samples of cements, sands, aggregates and color additives used in mockup for comparison with materials used in remaining work.
6. Aggregate selected must be tested to ensure it will accept polish.
7. Select from Part 3.3 – Schedules cut and shine level and finish coat.
8. Edges should be included in mockup.
9. Accepted mockup provides visual standard for work of Section.
10. Mockup shall remain through completion of work for use as a quality standard for finished work.
11. Remove mockup when directed, or if acceptable to the Architect the mockup may become part of the finished product.

L. Environmental Limitations:
1. Comply with manufacturer’s written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
2. Application of finish system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
3. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions. Deliver colored admixtures and liquid densifiers in original, unopened packaging. Store in dry conditions.

1.6 PROJECT CONDITIONS

A. Integrally Colored Concrete Environmental Requirements:
1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
2. Avoid placing concrete if rain is forecast within 24-hours. Protect fresh concrete from moisture.
3. Comply with professional practices described in ACI 305R and ACI 306R.

B. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturer’s written recommendations.

1.7 PRE-JOB CONFERENCE

A. One week prior to placement of integrally colored concrete a meeting will be held to discuss the Project and application materials.

B. It is suggested that the Architect, General Contractor, Subcontractor, Ready-Mix Concrete Representative, and a Manufacturer's Representative be present.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. L.M. SCOFIELD COMPANY, Douglasville, Georgia and Los Angeles, California (800) 800-9900 or the appropriate local contact: Eastern Division – 201-672-9050; Western Division – 714-568-1870; Central Division Office – 630-377-5959. Local Florida Contact: Steve Rissi – 727-515-1849

2.2 MATERIALS & EQUIPMENT

A. Colored Admixture for Integrally Colored Concrete: CHROMIX P® Admixture and CHROMIX ML®; L.M. SCOFIELD COMPANY.
   1. Admixture shall be a colored, water-reducing, admixture containing no calcium chloride with coloring agents that are limeproof and ultra-violet resistant.
   2. Colored admixture shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194.
   3. Color Selected: Per Architect from manufacturer's full color range.

B. Curing for Integrally Colored Concrete: Water based pigmented Curing Compound shall comply with ASTM C309 and be acceptable for use with integrally colored concrete.

   1. Lithochrome Colorwax to match integral colored concrete by the L.M. SCOFIELD COMPANY

C. Chemical Hardener/Densifiers Manufactured by L.M. SCOFIELD COMPANY:

   a. SCOFIELD® Formula One MP™ is a high performing liquid hardening and dust proofing compound that is chemically reactive and permanently bonds to concrete formulated to be used in conjunction with integrally colored concrete. (No substitutes)
   b. SCOFIELD® Formula One Guard-W Finish Coat

D. 3 head or 4 head counter rotating variable speed floor grinding machine with at least 600 pounds down pressure.

E. Dust extraction system, pre-separator, and squeegee attachments with minimum flow rating of 322 cubit feet per minute.

F. Protective Blanket System: Proguard DuraCover by L.M. SCOFIELD CO.

G. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:
   1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
   2. Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that Architect can examine.

2.3 COLORS

A. Concrete Color:
   1. Cement: Color shall be gray.
   2. Sand: Color shall be locally available natural sand.
   3. Aggregate: Concrete producer's standard aggregate complying with specifications.
   4. Colored Admixture: As selected by Architect from Scofield Color Chart A-312.

2.4 CONCRETE MIX DESIGN

A. Minimum Cement Content: 5 sacks per cubic yard of concrete.

B. Concrete fines to be natural sand

C. No Air Entraining Admixtures shall be used.

D. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches.

E. Do not add calcium chloride to mix as it causes mottling and surface discoloration.

F. Supplemental admixtures shall not be used unless approved by manufacturer.

G. Do not add water to the mix in the field.

H. Add colored admixture to concrete mix according to manufacturer's written instructions.

PART 3 – EXECUTION

3.1 CONCRETE INSTALLATION

A. Install concrete according to requirements of Division 3 Section “Cast-In-Place Concrete.”

B. Do not add water to concrete mix in the field.

C. Surfaces shall be finished uniformly with the following finish:
   1. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.
   2. Finish concrete shall have a minimum Floor Flatness rating of at least 50.
   3. Finish concrete shall have a minimum Floor Levelness rating of at least 30.

4. Finish concrete shall be cured a minimum of 28 days or at which point equipment can be put on the slab and does not displace aggregate.
5. Ground and Polished Concrete Surface: Precautions should be taken to insure the surface is in tolerances to perform this function.

3.2 CURING

A. Integrally Colored Concrete: Cure with color matched water based curing compound.

B. Do not cover concrete with plastic sheeting.

C. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 *Plastic Shrinkage Cracking* published by the National Ready Mixed Concrete Association.

3.3 MECHANICALLY POLISHED CONCRETE CUT AND SHINE LEVELS

A. Cut Level (Depth of cut)
   1. Grade 2 – light exposure of course aggregate
B. Shine Level
   2. Class 2 – 800 grit polish
C. Polished concrete finish coat
   1. At a distance of 100 feet, the floor will reflect images from side lighting.
   2. Apply two applications of SCOFIELD® Finish Coat.
D. Specified for project
   Grade: II
   Class: III
   Guard-W Finish Coat applications: 2

3.4 MECHANICALLY POLISHED CONCRETE APPLICATION

A. Applicator shall examine the areas and conditions under which work of this section will be provided and the General Contractor shall correct conditions detrimental to the timely and proper completion of the work and the Applicator shall not proceed until unsatisfactory conditions are resolved.

B. Grind the concrete floor to within 2 – 3 inches of walls with 150 grit removing construction debris, floor slab imperfections and until there is a uniform scratch pattern and desired concrete aggregate exposure - grinding 90 degrees from each previous grind and removing all the scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.

C. Grind the edges up to 150 grit grinding pads removing all the scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.

D. Fill construction joints and cracks with filler products as specified in accordance with manufacturer's instructions colored to match (or contrast) with concrete color as specified by architect.

E. Apply densifying impregnator undiluted at approximately 200-400 square feet per gallon using a stiff, long bristled broom. Cover the entire area liberally. Using a broom, work the

densifier into the substrate for 30 minutes. During this 30-minute period, continually keep the substrate wet with densifier. Squeegee excess material off the floor. Remove all residue by scrubbing and flushing surface with clean water Allow 12 to 24 hours undisturbed for full cure.

F. Polish the floor, to desired sheen level, with phenolic resin bonded diamond grits, first polishing the edges (if specified) with pads of the same grit and then the field of the floor removing all scratches from the previous grit. After each polish, clean the floor thoroughly using clean water and an auto scrubber or a mop and a wet vacuum.

G. Apply Guard-W Finish coat at 1000 square feet per gallon. Allow to dry 1-2 hours.

H. Using a high speed (2400 rpm) burnishing machine equipped with 800 grit diamond impregnated pads, buff the surface to a high shine.

I. Apply second application of Guard-W Finish Coat at 1000 sq.ft. per gallon. Allow to dry 1-2 hours.

J. Using a high speed (2400 rpm) burnishing machine equipped with 1500 grit diamond impregnated pads, buff the surface to a high shine.

K. Upon completion, the work shall be ready for final inspection and acceptance by the customer.

3.5 TOLERANCES

A. Minor variations in appearance of integrally colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

3.6 CLEANING

A. The work area shall be kept clean and free of debris at all times.

B. Remove slurry and dust from adjoining surfaces as necessary.

C. Dispose of material containers in accordance with local regulations.

D. Protect finished work until fully cured per manufacturer's recommendations.

3.7 PROTECTION

A. Protect concrete floors prior to as well as after the polishing process with ProGuard Dura Cover Protective Blankets by L.M. SCOFIELD.

3.8 APPLICATORS

A. For a list of qualified contractors, contact your local Florida Scofield representative: Steve Rissi – 727-515-1849 or the appropriate Division Office: Eastern Division – 201-672-9050; Western Division – 714-568-1870; Central Division Office – 630-377-5959.

END OF SECTION 033065

SECTION 033300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data for Credit MR 4.1: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit MR 5: For products of regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.

C. Design Mixtures: For each concrete mixture.

D. Formwork Shop Drawings.

E. Placement schedule.

F. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Chamfers and rustications.

1.4 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

1.5 QUALITY ASSURANCE

A. 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 three 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.

B. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the requirements indicated on the drawings. Mockups will not be incorporated into the work.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 303.1.

2.2 FORM-FACING MATERIALS

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for As-Cast Finishes: Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. Refer to drawings for specific intent for joint location.

C. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.

D. Form Ties: Factory-fabricated, removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.3 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."

1. Where legs of wire bar supports contact forms, use CRSI Class 1, gray, plastic-protected bar supports.

2.4 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

C. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I, white.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Water: Potable, complying with ASTM C 94/C 94M, except free of wash water from mixer washout operations.

2.5 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

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 CONCRETE MIXTURES

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. 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.

C. Concrete Mixtures:

1. Compressive Strength (28 Days): 4000 psi. Refer to structural specification sections and drawings.
2. Maximum W/C Ratio: 0.46.
3. Slump Limit: 4 inches, plus or minus 1 inch.

2.7 CONCRETE MIXING

A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. General: Comply with Section 033000 "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 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch.

D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ASI 117M).

E. Chamfer exterior corners and edges of cast-in-place architectural concrete.

F. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

G. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

H. 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 INSERT INSTALLATION

A. General: Comply with Section 033000 "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. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. 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.

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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

B. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Smooth-Formed Finish to 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 CONCRETE CURING

A. 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.
2. Curing compound.

3.8 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Section 033000 "Cast-in-Place Concrete."

3.9 REPAIR, 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 remainder of construction period.

END OF SECTION 033300

SECTION 035216 - LIGHTWEIGHT INSULATING CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place cellular foam lightweight insulating concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Include Owner and Architect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop drawings.

C. Design mixtures.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Evaluation reports.

1.5 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FM Global Listing: Lightweight insulating concrete along with other roofing components shall comply with requirements in FM Global 4454 as part of a roof assembly, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable.

2.2 CELLULAR LIGHTWEIGHT INSULATING CONCRETE

A. Produce cellular lightweight insulating concrete with the following minimum physical properties using cementitious materials, air-producing liquid-foaming agents complying with ASTM C 869/C 869M, and the minimum amount of water necessary to produce a workable mix:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Aerix Industries.
   b. Allied Foam Tech Corp.
   c. Celcore Incorporated.
   d. Elastizell Corporation of America.
   e. Siplast, Inc.

2. As-Cast Unit Weight: 34 to 42 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
3. Compressive Strength: Minimum 190 psi, when tested according to ASTM C 495.

2.3 MATERIALS

A. Cementitious Material: Portland cement, ASTM C 150/C 150M, Type I

B. Water: Clean, potable.

C. Joint Filler: ASTM C 612, Class 2, glass-fiber type; compressing to one-half thickness under a load of 25 psi.

D. Molded-Polystyrene Insulation Board: ASTM C 578, Type I, 0.90-lb/cu. ft. minimum density.

1. Provide units with manufacturer's standard keying slots or holes of 3 to 4 percent of board's gross surface area.

2.4 DESIGN MIXTURES

A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.

1. Limit use of fly ash to not exceed 25 percent of portland cement by weight.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301.

PART 3 - EXECUTION

3.1 PREPARATION

A. Control Joints: Install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight insulating concrete. Fill control joints with joint filler.

1. Provide 1-inch-wide control joints for roof dimensions up to 100 feet in length; 1-1/2-inch-wide control joints for roof dimensions exceeding 100 feet.

3.2 MIXING AND PLACING

A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture and loss of air content.

B. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards. Allow slurry coat to set prior to placing remaining thickness of lightweight insulating concrete.

1. Install insulation board in a stair-step configuration with a maximum step-down of 1 inch.

C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.

D. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.

E. Begin curing operations immediately after placement, and air cure for not less than three days, according to manufacturer's written instructions.

F. If ambient temperature falls below 32 deg F, protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

END OF SECTION 035216

SECTION 042000 - UNIT MASONRY

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 this Section.

1.2 RELATED SECTIONS

A. Section 018113 – LEED Requirements.

1.3 SCOPE OF WORK

A. Provide labor, material, equipment and perform operations necessary for, and incidental to, erection of masonry work.

B. Related sections: The following sections contain requirements that relate to this section:

1. Division 3 section "Cast-in-Place Concrete"

C. Products installed but not furnished under this Section include the following:

1. Steel lintels in unit masonry are specified in Division 5 Section "Metal Fabrication".
2. Wood nailers and blocking built into unit masonry are specified in Division 6 Section "Rough Carpentry".
3. Reglets in masonry joints for metal flashing are specified in Division 7 Section Flashing and Sheet Metal".
4. Hollow metal frames in unit masonry openings are specified in Division 8 Section "Steel Doors and Frames".
5. Hollow metal frames in unit masonry openings are specified in Division 8 Section "Custom Hollow Metal Work".
6. Sealants

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following installed compressive strengths (f'm):

1. f'm = 1500 psi on net area.

1.5 SUBMITTALS

A. Submit for review, manufacturers literature and/or drawings of material that is pre-fabricated or pre-assembled.

1. Product data for each different masonry unit, accessory, and other manufactured product indicated.
2. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.
3. Submitted shop drawings must be checked and signed by the General Contractor.
4. Material certificates signed by manufacturer and Contractor certifying that each type of masonry unit complies with requirements specified in referenced unit masonry standard, including fire performance characteristics.
5. Hot weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.
6. Results from tests and inspections performed by Owner's representatives will be reported promptly and in writing to Architect and Contractor.

B. LEED SUBMITTALS

1. Coordinate the required extent of each relevant construction phase credit.

2. Refer to the appropriate LEED version and rating system reference as dictated by the LEED project administrator.

3. Materials Resources:

a. MR-c4 (recycled content) - submit manufacturer's product data with information including complete recycled content including pre-consumer and post-consumer content percentages.

b. MR-c5 (regional materials) - submit manufacturer's product data with information including location of extraction, harvesting, and manufacturing miles from project.

c. MR-c7 (certified wood) – submit product data with information including quantities and chain of custody certification.

4. Indoor Environmental Quality:

a. EQ-c4.1 & EQ-c4.2 (low emitting materials) - submit manufacturer's product data with information including the voc levels of each product.

C. Refer to Section 013300 for all submittals.

1.6 QUALITY ASSURANCE

A. Unit masonry standard: ACI 530.1/ASCE 6 "Specifications for Masonry Structures".

B. Fire performance characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistances has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

C. Single source responsibility for masonry units: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from the manufacturer for each cementitious component and from one source and producer for each aggregate.

D. The contractor shall retain a qualified testing laboratory to perform the following tests:

1. Sample and test grout in accordance with ASTM C1019 for each 5000 square foot of masonry.
2. Slump tests - ASTM C143.

E. When requested by the Architect/Engineer, a qualified testing laboratory shall be retained to perform masonry prism test in accordance with ASTM E447, Method B, modified as follows:

1. Prisms shall be stack bond, one unit long and thick with a full mortar bed.
2. Limit height/thickness ratio from 1.33 - 5.00
3. Provide a minimum of one joint.

One set of three (3) prisms prior to construction and during construction for each 5000 square feet of wall.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry material to project in undamaged condition.

B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. Extend cover to minimum of 24 inches down both sides and hold cover securely in place.

C. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

D. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

E. Stain prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that come in contact with such masonry.

F. Protect base of walls from rain splashed mud and mortar splatter by means of covering spread on ground and over wall surface.

G. Protect sills, ledges, and projections from mortar droppings.

H. Protect surfaces of window and door frames, as well as similar products with painted and integral finish from mortar droppings.

I. Hot weather construction: Comply with referenced unit masonry standard.

PART 2 - GENERAL

2.1 MATERIALS - GENERAL

A. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.2 CONCRETE MASONRY UNITS

A. General: Comply with requirements indicated below applicable to each form of concrete masonry required.

B. Masonry Units for Fire-Rated Walls

1. Provide fire-rated units which are rated product of manufacturer listed in latest revision of building materials list, published by UL. In lieu of above rating, furnish fire resistive units on basis of examination, tests and report by nationally recognized testing agency acceptable to governing authorities and codes having jurisdiction. Report must state that units proposed to be furnished are equivalent in fire rating to those products furnished by producers in above UL building materials list.

C. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.

D. Concrete masonry units: Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings.

E. Provide Type II, non-moisture controlled units.

F. Exposed faces: Manufacturer's standard color and texture, unless otherwise indicated.

G. Hollow load-bearing concrete masonry units: ASTM C 90, Grade N and as follows:

1. Unit compressive strength: Provide units with minimum average net area compressive strength indicated below. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
2. Use inspection and cleanout holes at bottom of wall reinforced vertical cells for grouting lifts over 5 feet high. Cleanout holes should be 3" minimum, see ACI 530.1-02, Section 3.2F. See grout space requirements for various grout pour heights in ACI 530.1-02, Section 3.5C with Table 7.

H. Weight classification: Normal weight

2.3 MORTAR AND GROUT MATERIALS

A. Mortar - Type S

B. Grout - 2500 psi at 28 days

C. Portland cement: ASTM C 150, Type I or II. Provide natural color.

D. Ready-mixed mortar: Cementitious materials, water, and aggregate complying with requirements specified in this article, combined with set controlling admixtures to produce a ready-mixed mortar complying with ASTM C 270.

E. Hydrated lime: ASTM C 207, Type S.

F. Aggregate for mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

G. Aggregate for grout: ASTM C 404.

H. Water: Clean and potable.

2.4 REINFORCING STEEL

A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article, formed from the following:

1. Galvanized carbon steel wire, coating class as required by referenced unit masonry standard for application indicated.

B. Description: Welded wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner an tee units, and complying with requirements indicated below:

1. Wire diameter for side rods: 0.1483 inch (9 gage).

C. For single wythe masonry provide type as follows with single pair of side rods:

1. Ladder design with perpendicular cross rods spaced not more than 16 inches O.C.

D. For multi-wythe masonry provide type as follows:

1. Ladder design with perpendicular cross spaced not more than 16 inches O.C.
2. Number of side rods for multi wythe concrete masonry: One side rod for each face shell of hollow masonry units more than 4 inches or less in nominal width.

E. Tab design with single pair of side rods and rectangular box-type cross ties spaced not more than 16 inches O.C., with side rods spaced for embedment within each face shell of backup wythe and ties extended to engage the outer wythe by at least 1-1/2" inches.

F. Use units with adjustable two piece rectangular ties where horizontal joints of facing wythe do not align with those of backup by more than and where indicated.

G. Available manufacturers: Subject to compliance with requirements, manufacturers offering joint reinforcement that may be incorporated in the work include, but are not limited to, the following:

1. AA Wire Products/Hohmann & Barnard, Inc.
2. Dur-O-Wal, Inc.
3. Masonry Reinforcing Corporation of America

2.5 TIES AND ANCHORS

A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of reference unit masonry standard and this article.

B. Galvanized carbon steel wire: ASTM A 82, coating class as required by referenced unit masonry standard for application indicated.

C. Wire diameter: 0.1875 inch.

D. Galvanized heavy thickness steel sheet: ASTM A 635 (commercial quality) hot-rolled carbon steel sheet hot-dip galvanized after fabrication to comply with ASTM A 525, Class B3, for rigid anchors fabricated from steel sheet or strip with a thickness of 0.180 inch and greater.

E. Steel plates and bars: ASTM A 36, hot dipped galvanized to comply with ASTM A 123 or ASTM A 153, Class B3, as applicable to size and form indicated.

F. 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. Dur-O-Wal, Inc.
2. Heckman Building Products, Inc.
3. Hohmann & Barnard, Inc.

2.6 BENT WIRE TIES

A. Individual units prefabricated from bent wire to comply with requirements indicated below:

1. Tie shape for hollow masonry units laid with cells vertical: Rectangular with closed ends and not less than 4 inches wide.

B. Type for masonry where coursing between wythes align: Unit ties bent from one piece of wire.

C. Type for masonry where coursing between wythes does not align: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.

2.7 ADJUSTABLE ANCHORS FOR CONNECTING MASONRY TO STRUCTURAL WORK

A. General: Two piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.

B. For anchorage to concrete framework, provide manufacturer's standard with dovetail anchor section formed from sheet metal and triangular shaped wire ties section seized to extend within 1 inch of masonry face and as follows:

1. Wire diameter: 0.1875 inch

2.8 MISCELLANEOUS ANCHORS

A. Unit type masonry inserts in concrete: Cast iron or malleable iron inserts of type and sized indicated.

B. Dovetail slots: Furnished dovetail slots, with filler strips, or slot size indicated, fabricated from 0.0336 inch (22 gage) sheet metal.

2.9 POST-INSTALLED ANCHORS

A. Anchors as described below, with capacity to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

1. Type: Chemical anchors
2. Type: Expansion anchors

B. Corrosion protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).

C. For cast-in-place and post-installed anchors in concrete: Capability to sustain, without failure, a load equal to 4 times loads imposed by masonry.

D. For post-installed anchors in grouted concrete masonry units: Capability to sustain, without failure, a load equal to 6 times loads imposed by masonry.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Non-metallic expansion joint strips: Pre-molded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated, formulated from the following material:

1. Neoprene
2. Urethane
3. Polyvinyl chloride

B. Pre-formed control joint gaskets: Materials as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Styrene-Butadiene rubber compound: ASTM D 2000, Designation 2AA-805
2. Polyvinyl Chloride: ASTM D 2287, General Purpose Grade, Type PVC-65406

C. Bond breaker strips: Asphalt saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.11 MASONRY CLEANERS

A. Job mixed detergent solution: Solution of trisodium phosphate (1/2 cup dry measure) dissolved in one gallon of water.

B. Job mixed muriatic solution: Solution of 1 part muriatic acid and 10 parts clean water, mixed in a non-metallic container with acid added to water.

C. Proprietary acidic cleaner: Manufacturer's standard strength, general purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.

D. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface acting acids, cheating, and wetting agents.

E. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.

F. Available products: Subject to compliance with requirements, a product that may be used to clean until masonry surfaces includes, but is not limited to, the following:

1. "Sure Klean No. 600 Detergent", ProSoCo, Inc.
2. "Sure Klean No. 101 Lime Solvent", ProSoCo, Inc.
3. "Sure Klean Vana Trol", ProSoCo, Inc.

2.12 MORTAR AND GROUT MIXES

A. General: Do not add admixtures including coloring pigments, air-entraining agents, antifreeze compounds, or admixtures, unless otherwise indicated.

B. Do not use calcium chloride in mortar or grout.

C. Procedures of ASTM C780 is to be used to test and evaluate mortar and establish pre-construction datum and quality control testing for types of mortar indicated below:

1. Type S

D. Grout for unit masonry: Comply with ASTM C 476 and referenced unit masonry standard.

2.13 SOURCE QUALITY CONTROL

A. Concrete masonry unit tests: For each type, class, and grade of concrete masonry unit indicated, units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content per ASTM C 140, if required by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

A. Mix mortar and grout in power driven, drum type mixers. Operate mixer a minimum of 5 minutes after addition of all materials.

B. Comply with referenced unit masonry standard and other masonry construction to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required to accommodate items specified in this and other sections of the specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses. Coordinate masonry with all adjacent work of other trades.

D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

E. Cut masonry units with motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining constructions. Use full size units without cutting where possible.

F. Matching existing masonry: Where applicable, match coursing, bonding, color, and texture of new masonry with existing masonry.

G. Do not use masonry units with chips, cracks, voids, discolorations or other defects.

3.3 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of ACI 530 or N.C.M.A.

3.4 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

C. Bond pattern for exposed masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.

1. One half running bond with vertical joint in each course centered on units in courses above and below.

D. Lay concealed masonry with all units in a wythe in running bond or bounded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.

E. Stopping and resuming work: In each course, rack back 1/2 unit length for one-half running bond or 1/3 unit length for one -third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

F. Re-temper mortar as necessary to keep plastic. Use no mortar after setting has begun or after 2 1/2 hours of initial mixing.

G. Built-in work: As construction progresses, built-in items specified under this and other sections of the specifications. Fill in solidly with masonry around built-in items.

H. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

I. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

J. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

K. Reinforced vertical concrete blocks cells, grouting solid where indicated on plan.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows: With full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

3.6 HORIZONTAL JOINT REINFORCEMENT

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch of exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bed reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

D. Provide horizontal joint reinforcement at doors and windows for first and second block course above and below apertures. Run reinforcing continuous or extend two feet from aperture edge.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 26 inches o.c. horizontally.

3.8 MOVEMENT (CONTROL AND EXPANSION) JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond breaker strips on in ends of block units on one side of control joint. Fill the joint with mortar and rake joints in exposed faces.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide reinforced precast concrete lintels. Cure precast lintels before handling and installation.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 INSTALLATION OF REINFORCED UNIT MASONRY

A. General: Install reinforced unit masonry to comply with requirements or referenced unit masonry standard.

B. Temporary formwork: Construct formwork and shores to support reinforced masonry elements during construction. Contractor is completely responsible for the proper design and construction of all temporary forms and bracing.

C. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

D. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

E. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

C. Final cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet all surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean concrete masonry by means of cleaning method indicated in N.C.M.A. TEK 45 applicable to type of stain present on exposed surfaces.

D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of substantial completion.

END OF SECTION 042000

SECTION 051223 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All requirements of the general provisions of the contract including General and Supplementary Conditions, Division 0 and Division 1 forms a part of this section.

1.2 RELATED SECTIONS

A. Section 018113 – LEED Requirements.

1.3 DESCRIPTION

A. SCOPE OF WORK

1. This Section includes fabrication, delivery, unload and store in locations directed and erect all structural steel work, as shown on drawings and specified, including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

B. Related work not specified under this subdivision:

1. Steel joist
2. Setting of anchor bolts, cast in concrete, or masonry.
3. Metal fabrications.

1.4 SUBMITTALS

A. Submit for review, complete shop drawings covering fabrication and erection of all work under this subdivision, including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

B. Submitted shop drawings must be checked and signed by the General Contractor.

C. Test reports conducted on shop and field bolted and welded connections. Include data on type(s) of test conducted and test results.

D. LEED SUBMITTALS

1. Coordinate the required extent of each relevant construction phase credit.

2. Refer to the appropriate LEED version and rating system reference as dictated by the LEED project administrator.

3. Materials Resources:

   a. MR-c4 (recycled content) - submit manufacturer's product data with information including complete recycled content including pre-consumer and post-consumer content percentages.

   b. MR-c5 (regional materials) - submit manufacturer's product data with information including location of extraction, harvesting, and manufacturing miles from project.

   c. MR-c7 (certified wood) – submit product data with information including quantities and chain of custody certification.

4. Indoor Environmental Quality:

   a. EQ-c4.1 & EQ-c4.2 (low emitting materials) - submit manufacturer's product data with information including the voc levels of each product.

E. Refer to Section 013300 for all submittals.

1.5 QUALITY ASSURANCE

A. Codes and standards: Comply with applicable provisions of the latest issue of the following, except as otherwise indicated:

   1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges" - except paragraph 4.2.1. AISC "Specification for Structural Steel Buildings", including "Commentary".
   2. "Specifications and Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.
   3. Structural Welding Code (AWS D1.1)
   4. Steel Structures Painting Council (SSPC)

B. Qualifications for welding work: Qualify welding procedures and welding operations in accordance with AWS "Qualification" requirements.

C. Welders to have current certificates, If re-certification of welders is required, re-testing will be Contractor's responsibility.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress or work. Store on site only in authorized locations.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground. Protect steel members and packaged materials from exposure to the weather.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Misc. structural shapes, plates, etc...: ASTM A 36

B. Structural beams, columns, etc...: ASTM A36 or ASTM A992 GR.50 - Refer to structural drawings.

C. Hot-formed steel tubing: ASTM A 501

D. Steel pipe: ASTM A53, Type E or S, Grade B; or ASTM A501

E. Anchor bolts: ASTM A 307, non-headed type, with nuts and washers.

F. Unfinished threaded fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts, nuts, and washers. Provide hexagonal heads.

G. High strength threaded fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, complying with ASTM A325.

H. Electrodes for welding: Comply with AWS Code. Use E70XX electrodes.

I. Grout: non-shrink, non-metallic, flowable or plastic with minimum of 7,000 psi at 28 days in accordance with CRD-C 621, Army Corps of Engineers.

2.2 FABRICATION

A. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Properly mark-match materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

B. Work shall be executed by skilled workmen under experienced supervision.

C. Connections: Weld or bolt shop connections.

D. Bolt field connections with high-strength bolts, except where welded connections are indicated.

E. Field verify all existing dimensions and elevations prior to fabrication.

F. High strength bolted construction: Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A 325 Bolts". Use bearing type bolts with threads included in shear plane.

G. Welded construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welding work.

H. Holes for other work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

2.3 SHOP PAINTING

A. General: Shop paint all structural steel, except anchor bolts and surfaces to be field welded.

B. Paint all members after fabrication, except where surfaces would be inaccessible for surface prep and painting.

C. Apply paint in sufficient volume or coats to provide a minimum dry film thickness of 3 but not more than 5 mils.

D. Surface preparation: Clean steel in accordance with Steel Structures Painting Council (SSPC - SP3 Power Tool Cleaning).

2.4 SOURCE QUALITY CONTROL

A. General: Materials and fabrication procedures are subject to inspections at tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Promptly remove and replace materials or fabricated components that do not comply.

PART 3 - EXECUTION

3.1 ERECTION

A. Must conform to the applicable provisions of AISC specifications.

B. Temporary planking: Provide temporary planking and working platforms as necessary to effectively complete work.

C. Setting bases and bearing plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

D. All anchor bolts shall be built into connections work in advance.

E. Set loose and attached base plates and bearing plates for structural members on leveling nuts. Do not use wedges of shims.

F. 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.

G. Field assembly: Set structural frame accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

H. All bolts, including anchor bolts, shall have enough projection to expose not less than 1-1/2 threads after nuts is tightened. Level and plumb individual members of structure within specified AISC tolerances.

I. If steel is damaged or does not fit-up, Contractor shall submit proposed corrective measures for review by Engineer.

J. Do not enlarge unfair holes in members by burning or by using drift pins. Drill or ream holes that must be enlarged to accommodate next larger fastener, where possible.

K. The use of a gas cutting torch in field for correcting fabrication errors in primary structural members will not be permitted.

L. Immediately after erection, clean field welds, bolted connections, and abraded areas where shop coat was damaged. Spot and prime areas using same material as used for shop coat.

M. Set all members so that, in their final location, level, plumbness and alignment are within the tolerances prescribed by AISC Code.

3.2 QUALITY CONTROL

A. An independent testing and inspection agency shall be retained to inspect structural steel members high strength bolted connections and welded connections.

B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom. Submit 3 copies of each report to Owner's representative.

C. Provide access for testing agency to places where structural steel work is begin fabricated or produced so that required inspection and testing can be accomplished.

D. Minimum required testing:

1. Visually inspect all structural steel beams, columns, etc.
2. Visually inspect all bolted and welded connections.
3. Test all beam or column splices.
4. Test a representative sample of all full or partial penetration welds.

E. Correct deficiencies in structural steel work that inspections have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expenses, as necessary to reconfirm any non-compliance of original work and to show compliance of corrected work.

3.3 FINAL CLEANUP

A. All temporary guys, braces, falswork, cribbing, rubbish and other debris are to be removed upon completion of erection.

END OF SECTION 051223

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Section 018113 – LEED Requirements.

1.3 SCOPE OF WORK

A. Provide all equipment, labor and perform all work as necessary to fabricate, furnish, deliver, unload, store in locations directed and erect on supports to be provided under another subdivision all open-web steel joists and accessories as specified herein and as indicated.

B. Related work not specified under this subdivision:

1. Structural Steel
2. Steel and ironwork of a miscellaneous nature
3. Setting anchor bolts
4. Grouting bearing plates

1.4 QUALITY ASSURANCE

A. Provide joists fabricated in compliance with the following, as herein specified.

B. Steel Joist Institute (SJI) "Standard Specifications, Load Tables and Weight Table" for:

1. K-Series open web steel joists

C. Joist fabricator shall be a member of the Steel Joist Institute.

D. American Institute of Steel Construction (AISC)

E. American Welding Society (AWS)

F. Steel Structures Painting Council (SSPC)

G. Qualification of field welding: Qualify welding processes and welding operators in accordance with American Welding Society "Structural Welding Code", AWS D1.1

H. See Structural Steel 05120, 3.02 for testing requirements.

1.5 SUBMITTALS

A. Submit for review complete shop drawings covering, fabrication of all work under this subdivision including erection of such work on supports furnished under a separate subdivision.

B. Submitted shop drawings and calculations signed, sealed and dated by the Specialty Professional Engineer who is a Florida licensed Engineer in the structural discipline.

C. Design techniques, type, and format of supporting calculations, and all submittals must be reviewed by the Engineer-of-Record.

LEED Submittals

1. Coordinate the required extent of each relevant construction phase credit.

2. Refer to the appropriate LEED version and rating system reference as dictated by the LEED project administrator.

3. Materials Resources:

   A. MR-c4 (recycled content) - submit manufacturer's product data with information including complete recycled content including pre-consumer and post-consumer content percentages.

   B. MR-c5 (regional materials) - submit manufacturer's product data with information including location of extraction, harvesting, and manufacturing miles from project.

   C. MR-c7 (certified wood) – submit product data with information including quantities and chain of custody certification.

4. Indoor Environmental Quality:

   A. EQ-c4.1 & EQ-c4.2 (low emitting materials) - submit manufacturer's product data with information including the voc levels of each product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Joist shall be inspected by the manufacturer before shipment to insure compliance of materials and workmanship.

B. Deliver, unload, store in locations directed, and handle steel joists as recommended in SJI "Specifications". Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chord members: 50 ksi yield

B. Web members: 36 ksi or 50 ksi yield

C. If requested by owner's representative, evidence that the steel meets design yield strength shall be provided in the form of certified test reports.

D. Bearing plates ASTM A36.

E. High strength bolts ASTM A325.

F. Steel prime paint:

1. Steel Structures Painting Council specification 15-68T, Type I. Asphalt paint shall not be used.

2.2 FABRICATIONS

A. General: The design and manufacture of steel joists shall conform to the latest standard specifications and load tables for open web steel joists, as adopted by the Steel Joist Institute.

B. Holes in chord members: Provide holes in chord members where shown for securing other work to steel joists; however, deduct area holes from the area of chord when calculating strength member.

C. Extend ends: Provide extended ends on joists where shown, complying with manufacturer's standards and requirements of applicable SJI "Specification" and load tables.

D. Bridging: Provide horizontal or diagonal type bridging for joists and joist girders, complying with SJI "Specifications".

E. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

F. Splices: May occur at any point in the chord members and shall be butt welded splices developing 100% of the cross sectional area of the member splices, and shall develop a minimum tensile strength of 57,000 psi on the full cross sectional area.

G. Deflection: Live load deflections shall not exceed: 1/240 of span for roofs and 1/360 of span for floors.

H. Camber: See SJI specifications for required camber.

I. Shop painting: Prior to shipping, all joists shall be cleaned of rust and mill scale by brushing with steel bristle brushes and shall have one shop coat of paint meeting Steel Structures Painting Council Specification (SSPC) 15-68T, Type I, gray applied by either dipping and/or spraying.Shop coat of paint shall be 1 mil minimum.

PART 3 - EXECUTION

3.1 ERECTION

A. Place and secure steel joists in accordance with SJI "Specifications", final shop drawings, and as herein specified.

B. Anchors: Furnish anchor bolts, bearing plates, and other devices to be built into concrete and masonry construction.

C. Refer to Division 4 sections for installation of anchors set in masonry.

D. Placing joist: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

E. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.

F. Where "open web" joist lengths are 40 feet and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.

G. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

H. Uplift: See plan for net wind load uplifts on roofs. Steel joist bottom chords must safely resist the wind uplift. A single line of bottom chord bridging must be provided at the first panel point from each support.

I. Temporary bracing: Contractor shall provide any temporary bracing required to adequately distribute erection loads so that the carrying capacity of any individual joist is not exceeded.

J. Field weld or bolt joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used. Coordinate welding sequence and procedure with placing of joists.

K. Damaged joists: Shall be replaced at no additional cost to Owner.

L. Touch-up painting: After joist installation, paint field bolt heads and nuts, and welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

M. Do not permit any application of construction loads to joists unless all joists are fastened in place and permanent bridging installed.

N. Fasten joist and joist girders to structural steel at column lines by bolting per SJI standard specification provisions.

END OF SECTION 052100

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.

1.2 RELATED SECTIONS

A. Section 018113 – LEED Requirements.

1.3 DESCRIPTION

A. SCOPE OF WORK

1. This section includes fabrication, delivery, unload and store in locations directed and erect all roof deck units as shown on drawings and specified.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification section.

B. Product data including manufacturer's specifications and installation instructions for each type of decking and accessories.

C. Shop drawings showing layout and type of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, sump pans, cant strips, cut openings, special jointing, and other accessories.

D. Submitted shop drawings must be checked and signed by the General Contractor.

E. Welder certificate: Upon request, provide current welder certification.

F. LEED Submittals

1. Coordinate the required extent of each relevant construction phase credit.

2. Refer to the appropriate LEED version and rating system reference as dictated by the LEED project administrator.

3. Materials Resources:

a. MR-c4 (recycled content) - submit manufacturer's product data with information including complete recycled content including pre-consumer and post-consumer content percentages.

b. MR-c5 (regional materials) - submit manufacturer's product data with information including location of extraction, harvesting, and manufacturing miles from project.

c. MR-c7 (certified wood) – submit product data with information including quantities and chain of custody certification.

4. Indoor Environmental Quality:

a. EQ-c4.1 & EQ-c4.2 (low emitting materials) - submit manufacturer's product data with information including the voc levels of each product.

1.5 QUALITY ASSURANCE

A. Codes and standards: Comply with provisions of the following Codes and Standards, except as otherwise indicated:

1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members".
2. American Welding Society (AWS), D1.3 "Structural Welding Code - Sheet Steel".
3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks".

B. Qualification of field welding: Use qualified welding processes and welding operators in accordance with "Welder Qualifications" procedures of AWS. Welded decking in place is subject to inspection and testing.

C. FM listing: Provide steel roof deck units that have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for "Class I" fire-rated construction.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Roof deck to be 1-1/2 inch deep, 20 gauge, wide rib (Type B) with galvanized finish. Minimum properties are as follows. Computation of properties shall reflect the "Effective Compress Flange Width" concept.

   Maximum live load deflection = l/240 of span.
   Maximum working stress = 20 ksi

B. Floor deck to be 9/16 inches deep, 24 gauge, galvanized permanent composite form deck. Minimum properties are as follows:

2.2 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. Marlyn Steel Products, Inc.
   2. Vulcraft Div., Nucor Corporation

2.3 MATERIALS

A. Steel for galvanized metal deck units: A653 Grade 33 with coating designation G90.

B. Miscellaneous steel shapes: ASTM A 36.

C. Sheet metal accessories: ASTM A 924, galvanized, G90.

D. Galvanizing repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

E. Flexible closure strips: Manufacturer's standard mineral fiber closures.

F. Metal deck and sheet metal coating designation:

   1. With structural concrete or insulating concrete topping – G90
   2. Without structural concrete or insulating concrete topping – G60

2.4 FABRICATION

A. General: Form deck units in lengths to span three or more supports, with flush, telescoped, or nested 2 inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and width as indicated.

B. Roof deck units: Provide deck configurations that comply with SDI “Specification and Commentary for Steel Roof Deck".

C. Roof sump pans: Fabricate from single piece of 0.071 inch min. (14 gauge) galvanized sheet steel with level bottoms and sloping sides to direct water flow to draining. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess

pans not less than 1-1/2 inches below roof deck surfaces unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field by others.

PART 3 - EXECUTION

3.1 GENERAL

A. Delivery and storage: Deliver deck to job site in bundles and store off ground with one end elevated for water drainage. Cover with waterproof covering, ventilated to avoid condensation.

3.2 INSTALLATION

A. General: Install deck units and accessories in accordance with manufacturer's recommendations, shop drawings, and as specified herein.

B. Place deck units on supporting steel framework and adjust to final position with end accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.

C. Align deck units for entire length of run of cells and with close alignment between cells at ends of abutting units.

D. Place deck units flat and square, secured to adjacent framing without warp or deflection.

E. Suspended ceiling, light fixtures, ductwork, piling or other utilities shall not be suspended from decking.

F. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

G. Fasten roof deck to supporting steel by welding. See drawings for weld pattern.

H. Comply with AWS requirements and procedures for manual shielded metal arc weld, appearance and quality of welds, and methods used in correcting welded work. Minimum puddle welded size = 5/8 inch diameter.

I. Use care in selecting electrodes and amperage to provide positive weld and to prevent blow-out holes.

J. Use welding washers for all decking 24 gage or thinner.

K. Mechanically fasten side laps of adjacent deck units between supports with No. 10 self-tapping machine screws.

L. Uplift loading: Install and anchor roof deck units to resist gross uplift loading. See plan for uplift loading requirements.

M. Cutting and fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.

N. Reinforcement at openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

O. Roof sump pans: Place over openings provided in roof decking and weld to top decking surface. Space weld not more than 12 inches o.c. with at least one weld at each corner. Detail on architectural drawings.

P. Closure strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.

Q. Touch-up painting: After decking installation, wire brush, clean, and paint scarred areas, welds, and rust spots on top and bottom surfaces of decking units and supporting steel members.

R. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Metal ladders.
3. Elevator pit sump covers.
4. Metal bollards.

1.2 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2 Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and required connections to the structure.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

I. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

J. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," and Section 099123 Interior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch-diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung.
6. Galvanize exterior ladders, including brackets.
7. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from 3/16-inch abrasive-surface floor plate with four 1-inch-diameter holes for water drainage and for lifting. Refer to drawings for plate cover size.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Cap bollards with 1/4-inch-thick steel plate.

B. Fabricate bollards to be concrete filled and placed where indicated in a footer. Place level and plumb.

C. Prime bollards with zinc-rich primer. Paint as specified or as directed by the Architect.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.12 EXECUTION

2.13 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

2.14 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

2.15 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 ACTION SUBMITTALS

A. Product Data: For metal pan stairs.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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. Alfab, Inc.
2. American Stair, Inc.
3. Lapeyre Stair Inc.
4. Pacific Stair Corporation.
5. Worthington Metal Fabricators.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30, unless another grade is required by design loads.

1. Style Designation: Provide options for selection by Architect.

G. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

H. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

I. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

2.7 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel channels.

   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

2.8 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-1/2-inch-square top and bottom rails and 1-1/2-inch-square posts.
2. Picket Infill: 1/2-inch- **square** pickets spaced less than 4 inches clear.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes are okay as shown in NAAMM AMP 521.

C. Form changes in direction of railings by bending.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails.

G. Connect posts to stair framing by direct welding.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

2.9 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints.

D. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

E. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 055113

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum tube railings.

B. Related Requirements:

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

B. Sustainable Design Submittals:

   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Pipe and Tube Railings:

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      a. ATR Technologies, Inc.
      b. Superior Aluminum Products, Inc.
      c. Thompson Fabricating, LLC.
      d. Tri Tech, Inc.
      e. Wagner, R & B, Inc.
      f. Architects approved manufacturer’s

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.

C. Extruded Structural Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 FASTENERS

A. General: Provide the following:
   1. Aluminum Railings: Type 304 stainless-steel fasteners.

B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations: Alloy Group A1 stainless-steel bolts, ASTM F 738M, and nuts, ASTM F 836M.

2.6 MISCELLANEOUS MATERIALS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

G. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

D. Form changes in direction by inserting prefabricated elbow fittings.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.8 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 0.04 mm. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 2 mm in 1 m.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 6 mm in 3.5 m.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

A. Form or core-drill holes not less than 125 mm deep and 20 mm larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.3 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into appropriate wood backing between studs. Coordinate with stud installation to locate backing members.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood blocking, cants, and nailers.
2. Wood furring.
3. Wood sleepers.
4. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Chain-of-Custody Qualification Data: For manufacturer and vendor.
3. Product Data: For composite wood products, indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
5. Product Data: For installation adhesives, indicating VOC content.
6. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Regional Materials: The following wood products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

1. Dimension lumber.
2. Laminated-veneer lumber.

B. Regional Materials: The following wood products shall be manufactured within 500 miles of Project site.

1. Dimension lumber.
2. Laminated-veneer lumber.

C. Certified Wood: The following wood products shall be certified as "FSC Pure" according to FSC STD-01-00 and FSC STD-40-004.

1. Dimension lumber.
2. Laminated-veneer lumber.

D. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

E. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

F. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.4 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.5 METAL FRAMING ANCHORS

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. KC Metals Products, Inc.
2. Simpson Strong-Tie Co., Inc.
3. USP Structural Connectors.

B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a

qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

1. Adhesives shall have a VOC content of 70 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 064116 - PLASTIC-LAMINATE-FACED CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Solid Surfacing countertops with integral sinks.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
4. Hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including high-pressure laminate, Solid Surfacing products, hardware and accessories.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
4. Product Data: For adhesives, indicating that product contains no urea formaldehyde.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

D. Samples:

1. Plastic laminates, for each color, pattern, and surface finish.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program

B. Installer Qualifications: Installer shall also be the fabricator of products.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets 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.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide products by fabricator and installer able to meet all project requirements.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels from AWI certification program indicating that woodwork complies with requirements of grades specified.

B. Grade: Custom.

C. Regional Materials: Wood products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

D. Certified Wood: Wood products shall be certified as "FSC Pure" according to FSC STD-01-00 and FSC STD-40-004.

E. Type of Construction: Frameless.

F. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

G. Reveal Dimension: As indicated.

H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

I. 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. Abet Laminati Inc.
2. Formica Corporation.
3. Lamin-Art, Inc.
4. Pionite; a Panolam Industries International, Inc. brand.
5. Wilsonart LLC.

J. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Pattern Direction: As indicated or as indicated by the Architect.

K. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

L. Dust Panels: 1/4-inch plywood above compartments and drawers unless located directly under tops.

M. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range.

a. Solid colors, matte finish.
b. Solid colors with core same color as surface, matte finish.
c. Wood grains, matte finish.
d. Patterns, matte finish.

2.3 SOLID SURFACING COUNTERTOPS

A. Solid surfacing material: homogeneous solid sheet of filled plastic resin complying with ISSFA-2.
1. Manufacturer’s: Subject to compliance with requirements, provide products by one of the following:
a. E.I. du Pont de Nemours and Company.
b. Formica Corporation.
c. LG Chemical, Ltd.
d. Nevamar Company, LLC; Decorative Products Div.
e. Wilson International: Div of Premark International, Inc.
f. Architects approval.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Not allowed.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:

   1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

E. Catches: Magnetic catches, BHMA A156.9, B03141.

F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

H. Drawer Slides: BHMA A156.9.

   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
   5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
   6. For computer keyboard shelves, provide Grade 1.
   7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.

I. Door Locks: BHMA A156.11, E07121.

J. Drawer Locks: BHMA A156.11, E07041.

K. Door and Drawer Silencers: BHMA A156.16, L03011.

L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Adhesive specified above for faces.

2.7 FABRICATION

A. Complete fabrication, including assembly 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.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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.

C. Solid-Surfacing-Material Countertops:

1. Solid-Surfacing-Material Thickness: 1/2 inch.
2. Colors, Patterns, and Finishes: As indicated on the drawings and when not, as selected from manufacturers full color range.
3. Fabricate tops in one piece with shop-applied backsplashes. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
4. Install integral sink bowls in countertops in shop. Coordinate all required plumbing and fittings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

F. Kitchen and Shop Cabinet Legs: Adjust to level, refer to plan.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Glass Fiber blanket.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards."

B. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

C. 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. DiversiFoam Products.
2. Dow Chemical Company (The).
3. Owens Corning.

D. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

E. 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. DiversiFoam Products.
2. Dow Chemical Company (The).
3. Owens Corning.

2.2 GLASS-FIBER BLANKET

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. 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. CertainTeed Corporation.
2. Johns Manville; a Berkshire Hathaway company.
3. Owens Corning.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

1. Adhesives shall have a VOC content of 70 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

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

3.2 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 075216 - SBS-MODIFIED BITUMEN MEMBRANE ROOFING
(MECHANICALLY FASTENED SOPRAFIX OVER LIGHT WEIGHT CONCRETE)

PART 1 GENERAL

1.01 SUMMARY

A. Work shall include, but is not limited to, the following:
   1. Preparation of LWIC over steel roof deck, and all flashing substrates.
   2. SBS-modified bitumen base ply (mechanically fastened).
   3. SBS-modified bitumen Cap Sheet (heat-welded).
   4. SBS-modified bitumen membrane flashings.
   5. Protection membranes walking mats
   6. Liquid-applied, reinforced flashings.
   7. Sheet metal flashings.
   8. All related materials and labor required to complete specified roofing necessary to receive specified manufacturer's warranty.

1.02 RELATED DOCUMENTS

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

1.03 DEFINITIONS

A. ASTM D 1079-Definitions of Term Relating to Roofing, Waterproofing and Bituminous Materials.
B. The National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual, Fifth Edition Glossary.

1.04 PRE-INSTALLATION MEETINGS

A. Convene prior to commencing work at a time and location to be determined by the Owner/Owners Representative.

1.05 REFERENCES

A. AMERICAN SOCIETY OF CIVIL ENGINEERS - Reference Document ASCE 7, Minimum Design Loads for Buildings and Other Structures.
B. AMERICAN STANDARD OF TESTING METHODS (ASTM):
   1. ASTM C 726 - Standard Specification for Mineral Wool Roof Insulation Board.
   2. ASTM C 728 - Standard Specification for Perlite Thermal Insulation Board.

3. ASTM C 836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
4. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
5. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
6. ASTM C 1278 - Standard Specification for Fiber-Reinforced Gypsum Panel.
7. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Insulation Board.
8. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and Waterproofing.
9. ASTM D 312- Standard Specification for Asphalt Used in Roofing.
10. ASTM D 1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
11. ASTM D 2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
12. ASTM D 3019 - Standard Specification for Lap Cement Used with Asphalt Roll Roofing, Non-Fibered, Asbestos-Fibered, and Non-Asbestos-Fibered.
13. ASTM D 3746 - Standard Test Method for Impact Resistance of Bituminous Roofing System.
14. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
15. ASTM D 4601 - Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
16. ASTM D 5147 - Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
17. ASTM D 5849 - Standard Test Method for Evaluating Resistance of Modified Bituminous Roofing Membrane to Cyclic Fatigue (Joint Displacement)
18. ASTM D 6162 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
19. ASTM D 6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
20. ASTM D 6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
21. ASTM D 6298 - Standard Specification for Fiberglass Reinforced Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface.
22. ASTM D 7379 - Standard Test Methods for Strength of Modified Bitumen Sheet Material Laps Using Cold Process Adhesive.
23. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.

24. ASTM E 1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

C. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)::
1. ANSI/SPRI/FM 4435/ES-1 Wind Design Standard for Edge System Used with Low Slope Roofing System.
2. ANSI/SPRI FX-1, Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.
3. ANSI/SPRI IA-1, Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates.
4. ANSI/FM 4474- American National Standard for Evaluating the Simulated Wind Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures.

D. FACTORY MUTUAL (FM):
1. FM 4450 - Approval Standard - Class I Insulated Steel Roof Decks.
2. FM 4470 - Approval Standard - Class I Roof Covers.

E. BUILDING CODES:
1. Florida Building Code, 2010 edition.

F. NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA).

G. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION INC. (SMACNA) Architectural Sheet Metal Manual.

H. UNDERWRITERS LABORATORY (UL):
1. UL 790 Standard Test Methods for Fire Tests of Roof Coverings.
2. UL 1256 – Fire Test of Roof Deck Constructions.

1.06 ACTION SUBMITTALS

A. Product Data Sheets: Submit manufacturer's product data sheets, installation instructions and/or general requirements for each component.
B. Sample/Specimen Warranty from the manufacturer and contractor.
C. Shop Drawings: Provide roof plan and applicable roof system detail drawings.

1.07 INFORMATIONAL SUBMITTALS

A. Contractor Certification: Submit written certification from roofing system manufacturer certifying that the applicator is authorized by the manufacturer to install the specified materials and system.

1.08 CLOSEOUT SUBMITTALS

A. Warranty: Provide manufacturer's and contractor's warranties upon substantial completion of the roofing system.

1.09 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS:

1. Manufacture shall have 20 years of experience manufacturing SBS-modified bitumen roofing materials.
2. Trained Technical Field Representatives, employed by the manufacturer, independent of sales.
3. Provide reports in a timely manner of all site visit reports.
4. Provide specified warranty upon satisfactory project completion.

B. CONTRACTOR QUALIFICATIONS:

1. Contractor shall be authorized by the manufacturer to install specified materials prior to the bidding period through satisfactory project completion.
2. Applicators shall have completed projects of similar scope using same materials as specified herein.
3. Contractor shall provide full time, on-site superintendent or foreman experienced with the specified roof system through satisfactory project completion.
4. Applicators shall be skilled in the application methods for all materials.
5. Contractor shall maintain a daily record, on-site, documenting material installation and related project conditions.
6. Contractor shall maintain a copy of all submittal documents, on-site, available at all times for reference.

1.10 DELIVERY, STORAGE AND HANDLING

A. Refer to each product data sheet or other published literature for specific requirements.

B. Deliver materials and store them in their unopened, original packaging, bearing the manufacturer's name, related standards, and any other specification or reference accepted as standard.

C. Protect and store materials in a dry, well-vented, and weatherproof location. Only materials to be used the same day shall be removed from this location. During cold weather, store materials in a heated location, removed only as needed for immediate use.

D. When materials are to be stored outdoors, store away from standing water, stacked on raised pallets or dunnage, at least 4 in or more above ground level. Carefully cover storage with "breathable" tarpaulins to protect materials from precipitation and to prevent exposure to condensation.

E. Carefully store roof membrane materials delivered in rolls on-end with selvage edges up. Store and protect roll storage to prevent damage.

F. Properly dispose of all product wrappers, pallets, cardboard tubes, scrap, waste, and debris. All damaged materials shall be removed from job site and replaced with new, suitable materials.

1.11 SITE CONDITIONS

A. SAFETY:

1. The contractor shall be responsible for complying with all project-related safety and environmental requirements.
2. Heat-welding shall include heating the specified membrane ply using propane roof torches or electric hot-air welding equipment. The contractor shall determine when and where conditions are appropriate to utilize heat-welding equipment. When conditions are determined by the contractor to be unsafe to proceed, equivalent SBS-modified bitumen materials and methods shall be utilized to accommodate requirements and conditions.
3. Refer to NRCA CERTA recommendations, local codes and building owner's requirements for hot work operations.
4. The contractor shall review project conditions and determine when and where conditions are appropriate to utilize the specified liquid-applied, or semi-solid roofing materials. When conditions are determined by the contractor to be unsafe or undesirable to proceed, measures shall be taken to prevent or eliminate the unsafe or undesirable exposures and conditions, or equivalent approved materials and methods shall be utilized to accommodate requirements and conditions.
5. The contractor shall review project conditions and determine when and where conditions are appropriate to utilize the specified hot asphalt-applied materials. When conditions are determined by the contractor to be unsafe or undesirable to proceed, measures shall be taken to prevent or eliminate the unsafe or undesirable exposures and conditions, or equivalent approved materials and methods shall be utilized to accommodate requirements and conditions. .
6. The contractor shall refer to product Material Safety Data Sheets (MDS) for health, safety, and environment related hazards, and take all necessary measures and precautions to comply with exposure requirements.

B. ENVIRONMENTAL CONDITIONS:

1. Monitor substrate temperature and material temperature, as well as all environmental conditions such as ambient temperature, moisture, sun, cloud cover, wind, humidity, and shade. Ensure conditions are satisfactory to begin work and ensure conditions remain satisfactory during the installation of specified materials. Materials and methods shall be adjusted as necessary to accommodate varying project conditions. Materials shall not be installed when conditions are unacceptable to achieve the specified results.
2. Precipitation and dew point: Monitor weather to ensure the project environment is dry before, and will remain dry, during the application of roofing materials.

Ensure all roofing materials and substrates remain above the dew point temperature as required to prevent condensation and maintain dry conditions.

3. Mopping asphalt application: Primer, where used, shall be fully dry before applying hot asphalt. Take all necessary measures and monitor all conditions, to ensure the specified asphalt temperature is no less than 400°F (204°C) at the point of contact with the specified membrane as it is rolled into the hot asphalt.
4. Cold adhesive application: Primer, where used, shall be fully dry before proceeding. During cold weather, store the specified membrane adhesives, flashing cements and mastics in heated storage areas. Take all necessary measures and monitor application conditions, to ensure the adhesive and cement materials are no less than 70°F (21°C) at the point of contact with the membrane.
5. Self-adhered membrane application: During cold weather, store the specified self-adhered membrane and primer materials in heated storage areas to ensure materials remain no less than 70°F (21°C) during application. Ensure conditions allow primer to remain tacky, but not wet so that primer will transfer to finger when touched. Self-adhered primer should not fully dry and lose tack before applying the self-adhered membrane. Ensure conditions remain satisfactory to achieve membrane adhesion as specified.
6. Heat-Welding Application: Take all necessary precautions and measures to monitor conditions to ensure all environmental conditions are safe to proceed with the use of torches and hot-air welding equipment. Combustibles, flammable liquids and solvent vapors that represent a hazard shall be eliminated and primers shall be fully dry before proceeding with heat-welding operations. Refer to NRCA CERTA recommendations.

1.12 PERFORMANCE REQUIREMENTS

A. WIND UPLIFT RESISTANCE:
   1. Performance testing shall be in accordance with ANSI/FM 4474, FM 4450, FM 4470, UL 580 or UL 1897.
      a. Roof System Design Pressures: Calculated in accordance with ASCE 7, or applicable standard, for the specified roof system attachment requirements:
         i. Refer to structural drawings for requirements.

B. FIRE CLASSIFICATION:
   1. Performance testing shall be in accordance with UL 790, ASTM E108, FM 4450 or FM 4470.
      a. Meets requirements of UL Class A or FM Class A.
   2. Performance testing shall be in accordance with UL 1256, FM 4450 or FM 4470 to meet the specified requirements for interior flame spread and fuel contribution.
      a. Meets requirements of UL 1256, or FM Class 1.

C. ROOF SLOPE:

1. Finished roof slope for SBS modified bitumen surfaces shall be ¼ inch per foot (2 percent) minimum for roof drainage, or per code if in conflict.

D. IMPACT RESISTANCE:

1. Performance testing for impact resistance shall be in accordance with FM 4450, FM 4470, ASTM D3746 or CGSB 37-GP 56M to meet the specified impact resistance requirements.

a. Meets requirements for FM-SH (Severe Hail), ASTM D3746, or CGSB 37-GP 56M.

1.13 WARRANTY

A. Manufacturer's No Dollar Limit (NDL), Labor and Material Warranty. The manufacturer shall provide the owner with the manufacturer's labor and material warranty covering products and contractor workmanship for 20 years from the date of Substantial Completion.

B. The contractor shall guarantee the workmanship and shall provide the owner with the contractor's warranty covering workmanship for a period of 3 years from Substantial Completion date.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. SINGLE SOURCE MANUFACTURER: All SBS modified bitumen membrane and flashing sheets shall be manufactured by a single supplier with 20 years or more manufacturing history in the US.

B. PRODUCT QUALITY ASSURANCE PROGRAM: Manufacturer shall be an ISO 9001 registered company. A 'Quality Compliance Certificate (QCC) for reporting/confirming the tested values of the SBS-Modified Bitumen Membrane Materials will be supplied upon request.

C. ACCEPTABLE MANUFACTURER and basis-of-design:

1. SOPREMA, located at: 310 Quadral Dr.; Wadsworth, OH 44281; Tel: 800-356-3521; Tel: 330-334-0066; Website: www.soprema.us.

2.02 ROOFING SYSTEM

A. ROOFING SYSTEM BASIS OF DESIGN: SOPREMA

2.03 SBS-MODIFIED BITUMEN MEMBRANES

A. MECHANICALLY FASTENED MEMBRANE:

1. BASE PLY, MECHANICALLY FASTENED (SOPRAFIX):

a. SOPREMA Soprafix Base 612 [Soprafix (S)]: SBS-modified bitumen membrane ply with plastic burn-off film on the top and bottom surfaces.

Non-woven polyester reinforcement. Mechanically fastened in 4 in (minimum) heat-welded side-laps. Base ply for heat-welded cap sheet applications.

i. Thickness: 118 mils (3.0 mm)
ii. Width: 39.4 in (1 m)
iii. Length: 32.8 ft (10 m)
iv. Meets or exceeds ASTM D6164, Type I, Grade S.

B. FLASHING BASE PLY

1. FLASHING BASE PLY, HEAT-WELDED:

a. SOPREMA Sopralene Flam 180: SBS-modified bitumen membrane with plastic burn-off film on top and bottom surfaces. Non-woven polyester reinforcement.

i. Thickness: 120 mils (3.0 mm)
ii. Width: 39.4 in (1 m)
iii. Length: 32.8 ft (10 m)
iv. Meets or exceeds ASTM D6164, Type I, Grade S.

C. CAP SHEET/FLASHING CAP SHEET:

1. CAP SHEET/ FLASHING CAP SHEET, HEAT-WELDED:

a. SOPREMA Soprastar Flam: SBS-modified bitumen membrane Cap Sheet, with a burn-off film bottom surface and highly reflective, film top surface. Composite glass fiber and non-woven polyester reinforced. UL Class A for specified roof slope requirements.

i. Thickness: 138 mils (3.5 mm)
ii. Width: 39.4 in (1 m)
iii. Length: 32.8 ft (10 m)
iv. Meets or exceeds ASTM D6162, Type I, Grade S.
v. Highly reflective film surfacing, listed by the Cool Roof Rating Council (CRRC):

a) Solar Reflectance: Initial: 0.78 3-year: 0.74
b) Thermal Emittance: Initial: 0.89 3-year: 0.66
c) Solar Reflectance Index (SRI): Initial:97
3-year: 86

vi. EPA EnergyStar Certified Roofing Product:

a) Emittance: Initial: 0.89

2.04 ACCESSORIES

A. PRIMERS:

1. SOPREMA Elastocol 500 Primer: Asphalt cut-back primer. Primer for the preparation of roof membrane and flashing substrates for asphalt, heat-welded, hot asphalt and cold adhesive-applied applications.

a. Meets or exceeds ASTM D41
b. VOC content: 350 g/L or less.

B. FLASHING CEMENT

1. SOPREMA COLPLY Flashing Cement: SBS-modified bitumen membrane flashing cement for use with sanded base ply flashing and granule-surfaced Cap Sheet flashing.
    a. VOC Content: 250 g/L or less.
    b. Meets or exceeds ASTM D4586
2. SOPREMA COLPLY Modified Flashing Cement: Premium SBS-modified bitumen membrane flashing cement for use with sanded base ply flashing and granule-surfaced Cap Sheet flashing. Required for SOPREMA Soprastar Sanded Cap Sheet flashing applications.
    a. VOC Content: 250 g/L or less.
    b. Meets or exceeds ASTM D3019
3. SOPREMA COLPLY EF Flashing Cement: Premium , non-toxic, low-odor, solvent-free, polymeric membrane flashing cement for use with sanded base ply and all sanded Cap Sheet flashing applications.
    a. VOC Content: 32 g/L or less VOC Content.

C. GENERAL PURPOSE ROOFING CEMENT AND MASTIC
1. SOPREMA Sopramastic: SBS Mastic. Fiber-reinforced, roofing cement, packaged in 5 gallon pails. General purpose roofing cement for low-slope roofing used for sealing membrane T-joints and membrane edges along terminations, transitions and at roof penetrations.
    a. VOC Content: 190 g/L or less.
    b. Meets or exceeds ASTM D4586, Type I, Class II.
2. SOPREMA Sopramastic: SBS Mastic. Fiber-reinforced, roofing cement, packaged in 10.4 oz caulk tubes. General purpose roofing cement for low-slope roofing used for sealing membrane T-joints and membrane edges along terminations, transitions and at roof penetrations.
    a. VOC Content: 190 g/L or less.
    b. Meets or exceeds ASTM D4586, Type I, Class II.

D. GENERAL PURPOSE SEALANT
1. SOPREMA Sopramastic SP1: General purpose, gun-grade, elastomeric sealant for sealing vertical joints/cracks.
    a. VOC Content: 20 g/L or less.
    b. Meets or exceeds ASTM C920, Type S, Grade NS, Class 50.

E. MEMBRANE FASTENERS AND PLATES
1. SOPREMA #15 HD Fastener: Membrane base ply fastener.
2. SOPREMA Soprafix MBB-R: Membrane in-seam recessed batten bar.

F. SURFACE FINISH
1. SOPREMA Alsan Finish Alsan Finish LO (Low Odor): Bright white, two-component, liquid resin, un-reinforced surface finish. Soprastar membrane touch-up and film surface restoration.
    a. Meets UL Class A when applied to specified roofing system.
    b. Application Rate: 1.0 gallon per square minimum.

G. EXPANSION JOINT:

1. SOPREMA Soprajoint: Low-profile, polyester knit-reinforced, SBS-modified bitumen expansion joint membrane. Top surface consists of an aluminum-clad bond-breaker, with plastic burn-off film on the bottom surface for torch or hot air welding.
    a. Thickness: 160 mils (4.0 mm)
    b. Width: 18 in (457 mm)
    c. Roll Length: 32.8 ft (10 m)
    d. Expansion joint, maximum unsupported span: 2 in (51 mm)
    e. Expansion joint, maximum displacement: 5/8 in (16 mm)

H. SHEET METAL FLASHING:
1. Contractor shall furnish all sheet metal flashings, counter flashings, roof edge system, and all other related sheet metal flashings and associated fasteners necessary to flash and counter flash the specified roofing system.
2. Sheet metal flashing materials and fasteners shall be compatible with adjacent materials, to accommodate all project related exposures.
3. Pre-Finished (Mill Finished) Sheet Metal Flashing Material: Aluminum.
4. Roof Edge System: Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.

I. SHEET METAL, ROOF EDGE SYSTEM:
1. Roof edge system shall include all components and associated fasteners included by the manufacturer to comply with specified performance requirements. Contractor shall provide all other related fasteners and sealants not provided as part of the roof edge system, and required in the manufacturer's product data sheets.
2. SOPREMA SopraCap/SopraCap Plus Parapet Coping, Hickman Engineered System, PermaSnap/PermaSnap Plus: Engineered metal coping with hold-down cleats.
    a. Material: Aluminum
    b. Gauge/Thickness: 0.063 in aluminum
    c. Cleat: Galvanized Steel (SopraCap: 20 gauge-FM 1-90)
    d. Finish: Mill-Finished Aluminum.
    e. Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.
    f. FM Approved.
3. SOPREMA SopraEdge Extruded Roof Edge, Hickman Engineered System, Extruded Terminedge for BUR & MOD BIT: Engineered two-piece fascia system with an extruded aluminum retainer base plate and a formed metal fascia.
    a. Material: Aluminum
    b. Gauge/Thickness: 0.063 in aluminum
    c. Base: 0.100 in extruded aluminum
    d. Finish: Mill-Finished Aluminum.
    e. Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.

f. FM Approved.

4. SOPREMA SopraSpan Expansion, Hickman Engineered System, Permaspan Roof Expansion Joint, (Roof/Roof-to-Wall) Expansion Joint: Engineered, formed metal expansion joint cover with a continuous articulating anchor cleat.
   a. Material: Aluminum
   b. Gauge/Thickness: 0.063 in aluminum
   c. Cleat: 20 gauge Galvanized steel.
   d. Finish: Mill-Finished Aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examination includes visual observations, qualitative analysis, and quantitative testing measures as necessary to ensure conditions remain satisfactory throughout the project.

B. The contractor shall examine all roofing substrates including, but not limited to: insulation materials, roof decks, walls, curbs, rooftop equipment, fixtures, and wood blocking.

C. The applicator shall not begin installation until conditions have been properly examined and determined to be clean, dry and, otherwise satisfactory to receive specified roofing materials. Once application has commenced contractor accept surface for installation of roofing products.

D. During the application of specified materials, the applicator shall continue to examine all project conditions to ensure conditions remain satisfactory to complete the specified roofing system.

3.02 PREPARATION

A. Before commencing work each day, the contractor shall prepare all roofing substrates to ensure conditions are satisfactory to proceed with the installation of specified roofing materials. Preparation of substrates includes, but is not limited to, substrate repairs, securement of substrates, eliminating all incompatible materials, and cleaning.

B. Where conditions are found to be unsatisfactory, work shall not begin until conditions are made satisfactory to begin work. Commencing of work shall indicate contractor's acceptance of conditions.

3.03 PRIMER APPLICATION

A. Apply the appropriate specified primer to dry, compatible substrates as required to enhance adhesion of new specified roofing materials.

B. Apply primer using brush, roller, or sprayer at the rate published on the product data sheet.

C. Fully prime substrates using brush, roller, or sprayer at the application rate published in the product data sheet

D. Asphalt Primer: Apply primer to dry compatible masonry, metal, wood and other required substrates before applying asphalt and heat-welded membrane plies. Primer is optional for most solvent based solvent-based SBS adhesives and cements, refer to product data sheets.

E. Self-Adhered Membrane Primer: Apply to dry, compatible substrates as required to enhance adhesion of self-adhered membrane plies. Ensure self-adhered membrane primer is tacky to-the-touch, but not wet. Primer should not transfer to the finger tips when touched.

F. Do not proceed applying self-adhered membrane if primer is wet. If self-adhered membrane primer becomes fully dry and looses all tack, re-prime the substrate as necessary to achieve membrane adhesion.

G. Project conditions vary throughout the day. Monitor changing conditions, monitor the drying time of primers, and monitor the adhesion of the membrane plies. Adjust primer and membrane application methods as necessary to achieve the desired results.

3.04 HEAT WELDING

A. The Contractor is responsible for project safety. Where conditions are deemed unsafe to use open flames, manufacturer's alternate membrane application methods shall be used to install SBS modified bitumen membrane and flashings. Acceptable alternate installation methods include hot asphalt, cold adhesive-applied, self-adhered membranes and mechanically fastened plies. Hot-air welding equipment may be used in lieu of roof torches to seal membrane side and end laps where heat welding the laps is necessary. Refer to NRCA CERTA, local codes and building owner's requirements for hot work operations.

B. Single or multi-nozzle, hand-held propane roof torches shall be used to install heat-welded membrane and flashing plies. Multi-nozzle carts (dragon wagons) may also be utilized to install membrane plies. Seven (7) nozzle carts are recommended for more uniform heat application in lieu of five (5) nozzle carts.

3.05 FLASHING CEMENT APPLICATION

A. The ambient temperature shall be above 50°F (10°C), and the flashing cement temperature shall be a minimum of 70°F (21°C) at the point of membrane application.

B. To ensure the flashing cement is applied at 70°F (21°C), during cold weather, pails shall be stored in heated areas. Pails exposed to cold temperature on the roof shall be provided with heaters when necessary to ensure the minimum application temperature is maintained

C. Priming substrates is optional when solvent-based flashing cements are used. Primer may be applied to reduce adhesive consumption rates for some absorptive substrates.

D. Apply the flashing cement to dry, compatible substrates. Apply flashing cement using a ¼ inch notched trowel. Apply 2.0 – 2.5 gallons per square to each surface. Application rates vary based on substrate porosity and roughness.

3.06 SBS MASTIC AND GENERAL PURPOSE ROOFING CEMENT APPLICATION

A. Apply general purpose SBS mastic and roofing cement to seal drain leads, metal flanges, seal along membrane edge at terminations, and where specified and required in detail drawings.

B. Do not use general purpose SBS mastics and roofing cement where flashing cement applications are required. Do not use SBS mastics and roofing cement beneath SBS-modified bitumen membrane and flashing plies.

C. Apply general purpose SBS mastic and elastic roofing cement using caulk gun, or notched trowel at 2.0 – 2.5 gallons per square on each surface. Application rates vary based on substrate porosity and roughness. Tool-in as necessary to seal laps

D. Embed matching granules into wet cement where exposed.

3.07 MECHANICALLY FASTENED MEMBRANE, BASE PLY APPLICATION (SOPREMA SOPRAFIX)

A. Refer to agency approvals for base ply fasteners and other system requirements.

B. The design professional is responsible for determining specific project requirements.

C. Mechanically fastened membrane base ply installation:

1. Follow product data sheets and published detail requirements for additional installation instructions.
2. Ensure environmental conditions are satisfactory, and will remain satisfactory, during the application.
3. Unroll the sheet onto the roof surface and allow the sheet to relax before fastening. The sheet should relax in order to prevent wrinkling once fastened.
4. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps.
5. Remove all wrinkles from the base ply sheet.
6. Ensure all roofing and flashing substrates are prepared and acceptable to receive the mechanically fastened membrane.
7. Ensure the specified side-lap and end-lap widths are maintained. End-laps should be staggered 3 ft. apart.
8. Unroll the first roll onto the roof substrate, re-roll the adjacent roll.
9. Starting at one end of the sheet, install the mechanical fasteners along the center of the side-lap. Ensure spacing between fasteners in the laps meets specified wind uplift resistance requirements.

10. Do not over-drive fasteners. Install fasteners as necessary to firmly set the fastener and seam plate tight against the sheet. Prevent wrinkles from forming in the base ply sheet as fasteners are installed.
11. At the end of the base ply where it terminates at roof edges, walls and curbs, fasten the end-lap of the membrane to the deck 12 inches on-centers or less.
12. When the side-lap is fastened, un-roll the adjacent roll over the fasteners. Maintain the required side-lap width.
13. Ensure the full side-lap width, and all 6 inch end-laps, are sealed water-tight.
14. For heat-welded side-laps, apply heat to the underside of the roll at the side-laps while unrolling the membrane. Apply heat until the plastic burn-off film melts away. Ensure a continuous weld is produced across the full side-lap width.
15. For hot-air welded side-laps, insert the hot-air welder shoe within the lap, and adjust the hot-air welder as required to produce a continuous weld across the full lap width.
16. While heat-welding the membrane side-laps, ensure approximately ¼ inch bleed-out is achieved at laps.
17. Adjust the application of heat to the underside of the membrane and to substrate as required for varying substrates and environmental conditions.
18. For self-adhered side-laps, remove the release film on the underside of the membrane, while immediately following with a steel roller. Immediately heat-weld all 6 inch end-laps, and fully seal all T-joints.
19. At the end-laps, melt the plastic burn-off film from the surface using a torch or hot-air welder.
20. At end-laps, cut a 45 degree dog-ear away from the selvage edge, or otherwise ensure the membrane is fully heat-welded watertight at all T-joints.
21. Each day, physically inspect all side and end-laps, and ensure the membrane is sealed watertight. Where necessary, use a torch or hot-air welder and a clean trowel to ensure all laps are sealed.
22. Offset Cap Sheet side and end-laps away from the base ply laps so that Cap Sheet laps are not located within 18 inches of base ply laps.
23. Install membrane inter-ply and/or cap sheet over completed base and flashing base ply.
24. Inspect the installation each day to ensure the plies are fully adhered. Repair all un-adhered voids, wrinkles, open laps and all other deficiencies.

3.08 HEAT-WELDED, FULLY ADHERED MEMBRANE APPLICATION

A. Follow material product data sheets and published general requirements for installation instructions.
B. Ensure environmental conditions are satisfactory, and will remain satisfactory, during the application of the heat-welded membrane.
C. Ensure all primers are fully dry before beginning heat-welding operations.

D. Unroll membrane onto the roof surface and allow to relax prior to installing the membrane.

E. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps.

F. Ensure all roofing and flashing substrates are prepared and acceptable to receive the heat-welded membrane.

G. Cut rolls to working lengths to conform to roof conditions, and lay out to always work to a selvage edge.

H. Ensure specified side-laps and end-laps are maintained. End-laps should be staggered 3 ft apart.

I. As the membrane is un-rolled, apply heat to the underside of the membrane until the plastic burn-off film melts away. Continuously move the torch back-and-forth across the underside of the roll to melt the bitumen on the underside of the sheet, while continuously unrolling sheet.

J. While unrolling and heating the sheet, ensure a constant flow hot bitumen approximately ¼ to 1/2 in flows ahead of the roll as it is unrolled, and there is 1/8 to 1/4 in bleed out at all laps.

K. Adjust the application of heat to the underside of the membrane and to substrate as required for varying substrates and environmental conditions.

L. At the 6 in end-laps, melt the plastic burn-off film from the top surface or embed granules, where present, using a torch or hot-air welder.

M. At end-laps, cut a 45 degree dog-ear away from the selvage edge, or otherwise ensure the membrane is fully heat-welded watertight at all T-joints.

N. Each day, physically inspect all side and end-laps, and ensure the membrane is sealed watertight. Where necessary, use a torch or hot-air welder and a clean trowel to ensure all laps are sealed.

O. Inspect the installation each day to ensure the plies are fully adhered. Repair all voids, wrinkles, open laps and all other deficiencies.

P. Offset cap sheet side and end-laps away from the base ply laps so that Cap Sheet laps are not located within 18 in of base ply laps.

3.09 FLASHING APPLICATION, HEAT WELDED

A. Refer to SBS manufacturer's membrane application instructions, flashing detail drawings, and follow product data sheets and other published requirements for installation instructions. Refer to manufacturer's membrane flashing detail drawings.

B. The contractor is responsible for project safety. Refer to NRCA CERTA recommendations and building owner requirements for hot work operations.

C. Where required to seal substrates for fire safety, install specified adhered, self-adhered or fastened backer ply to the substrate. Ensure backer-ply covers and seals all substrates requiring protection from exposure to torch operations.

D. Ensure all flashing substrates that require primer are primed, and the primer is fully dry.

E. Unroll the flashing base ply and flashing Cap Sheet onto the roof surface to their complete length. Once relaxed, cut the membrane to the required working lengths to accommodate the flashing height, cants and the required over-lap onto the horizontal roof surface.

F. Cut the flashing membrane from the end of the roll in order to always install flashings to the side-lap line or selvage edge line.

G. Lay out the flashing base ply and flashing Cap Sheet to offset all side-laps a minimum of 12 inches so that side-laps are never aligned on top of the ply beneath. Shingle the flashing ply laps to prevent back-water laps.

H. Install non-combustible cant strips at transitions where required.

I. Ensure correct membrane and flashing sequencing to achieve redundant, multi-ply, watertight flashings.

J. ROOF MEMBRANE BASE PLY:

1. Before installing flashings, install the roof membrane base ply in the horizontal field of the roof, and extend the base ply up to the top of the cant, where present, at roof terminations, transitions and penetrations.

K. FLASHING BASE PLY:

1. Install the flashing base ply starting at the top leading edge of the vertical flashing substrate, down over the cant and onto the horizontal surface of the roof a minimum of 3 inches beyond the of base of the cant. Cut the base ply at corners to form 3 inch side-laps. Install gussets to seal corner transitions.
2. Install one or more flashing base ply(s) at all roof terminations, transitions and penetrations.

L. ROOF MEMBRANE CAP SHEET:

1. Install the roof membrane Cap Sheet in the horizontal field of the roof over the flashing base ply up to the roof termination, transition or penetration, and up to the top of cants where present.
2. Using a chalk line, mark a line on the membrane Cap Sheet a minimum of 4 inches from the base of the cant onto the roof. Where granules are present, embed the Cap Sheet granules using a torch and trowel or granule embedder to prepare the surface to receive the flashing Cap Sheet.

M. FLASHING CAP SHEET:

1. Install the flashing Cap Sheet starting at the top leading edge on the vertical substrate, over the cant and onto the roof surface 4 inches from the base of the cant.
2. Install the flashing Cap Sheet to ensure a minimum two (2) ply flashing system is present at all roof terminations, transitions and penetrations.

N. During the membrane and flashing installation, ensure all plies are completely adhered into place, with no bridging, voids or openings. Ensure bitumen or flashing cement bleed-out is present at all flashing side and end-laps.

O. Use a damp sponge float or damp rag to press-in the heat-welded flashing plies during installation.

P. Where sufficient bitumen bleed-out is not present, and for all self-adhered plies, apply specified gun-grade sealant or mastic to seal the membrane termination along all roof terminations, transitions and penetrations. These include gravel stop edge metal, pipe penetrations, along the top edge of curb and wall flashing, and all other flashing terminations where necessary to seal flashings watertight.

Q. Fasten the top leading edge of the flashing 8 in on-centers with appropriate 1 in cap nails or other specified fasteners. Seal fastener penetrations watertight using specified sealant or mastic.

R. Manufacturer's liquid-applied, reinforced flashing systems shall be installed where conditions are not favorable to install SBS modified bitumen flashings. Such conditions include irregular shapes penetrating roof surfaces (I-beams), confined areas and low flashing heights. Manufacturer's liquid-applied, reinforced flashing systems are recommended in lieu of pitch pans and lead pipe flashings. Refer to manufacturer's installation guidelines (SOPREMA ALSAN FLASHING AND ALSAN RS).

3.10 LIQUID-APPLIED, SINGLE-COMPONENT, BITUMEN-URETHANE FLASHING SYSTEM APPLICATION (SOPREMA ALSAN FLASHING):OPTIONAL

A. Refer to manufacturer's details drawings, product data sheets and published general requirements for application rates and specific installation instructions

B. Pre-cut polyester reinforcing fleece to conform to roof terminations, transitions and penetrations being flashed. Ensure a minimum 2 in overlap of fleece at side and end-laps. Ensure the completed liquid-applied flashing membrane is fully reinforced.

C. Apply the base coat of liquid-applied flashing resin onto the substrate using a brush or roller, working the material into the surface for complete coverage and full adhesion.

D. Immediately apply the reinforcing into the wet base coat of resin. Using a brush or roller, work the into the wet resin while applying the second coat of resin to completely encapsulate the fleece.

E. Allow the liquid membrane to sufficiently cure for 24 to 48 hours, then apply the finish coat of resin.

F. Broadcast mineral granules into the wet finish coat as required to match the adjacent cap sheet.

G. For SOPREMA Soprastar cap sheets, allow the system to completely cure for 48 hours or more, then apply the liquid-applied surfacing to match the adjacent Soprastar cap sheet. Refer to SOPREMA ALSAN FINISH product data sheets and installation instructions.

3.11 LIQUID-APPLIED, PMMA MEMBRANE AND FLASHING SYSTEM APPLICATION (ALSAN RS ALSAN RS LO)

A. Refer to manufacturer's details drawings, product data sheets and published general requirements for application rates and specific installation instructions.

B. Pre-cut polyester reinforcing fleece to conform to roof terminations, transitions and penetrations being flashed. Ensure a minimum 2 in overlap of fleece at side and end-laps. Ensure the completed liquid-applied flashing membrane is fully reinforced.

C. Apply the base coat of catalyzed resin onto the substrate using a brush or roller, working the material into the surface for complete coverage and full adhesion.

D. Immediately apply the reinforcing into the wet base coat of resin. Using a brush or roller, work the reinforcing fabric into the wet resin while applying the second coat of catalyzed resin to completely encapsulate the fleece.

E. Refer to reinforced, polymethyl-methacrylate (PMMA) specification section and application instructions, details drawings, product data sheets and published general requirements for installation instructions.

3.12 SHEET METAL FLASHING APPLICATION

A. Refer to sheet metal flashing detail drawings, and follow product data sheets and published general requirements for installation instructions.

B. Follow the most recent edition of the SMACNA Architectural Sheet Metal Manual for fabrication and installation requirements.

3.13 WALKWAYS

A. At areas outlined on the drawings, and around the perimeter of all rooftop equipment and at all door and stair landings, install walkway protection.

B. Cut walkway from end of rolls. No piece shall be less than 24 in.

C. Provide a 2 inch space between sheets for drainage.

3.14 CLEAN-UP

A. Clean-up and properly dispose of waste and debris resulting from these operations each day as required to prevent damages and disruptions to operations.

END OF SECTION 075216

SECTION 075217- SBS-MODIFIED BITUMEN MEMBRANE ROOFING (HEAT WELDED)

PART 1 GENERAL

1.01 SUMMARY

A. Work shall include, but is not limited to, the following:
1. Preparation of concrete roof deck, and all flashing substrates.
2. SBS-modified bitumen base ply(s) (heat-welded).
3. SBS-modified bitumen Cap Sheet (heat-welded).
4. SBS-modified bitumen membrane flashings.
5. All related materials and labor required to complete specified roofing necessary to receive specified manufacturer's warranty.

1.02 RELATED SECTIONS

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

1.03 DEFINITIONS

A. ASTM D 1079-Definitions of Term Relating to Roofing, Waterproofing and Bituminous Materials.
B. The National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual, Fifth Edition Glossary.

1.04 PRE-INSTALLATION MEETINGS

A. Convene prior to commencing work at a time and location to be determined by the Owner/Owners Representative.

1.05 REFERENCES

A. AMERICAN SOCIETY OF CIVIL ENGINEERS - Reference Document ASCE 7, Minimum Design Loads for Buildings and Other Structures.
B. AMERICAN STANDARD OF TESTING METHODS (ASTM):
1. ASTM C 726 - Standard Specification for Mineral Wool Roof Insulation Board.
2. ASTM C 728 - Standard Specification for Perlite Thermal Insulation Board.
3. ASTM C 836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
4. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants

5. ASTM C 1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
6. ASTM C 1278 - Standard Specification for Fiber-Reinforced Gypsum Panel.
7. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Insulation Board.
8. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and Waterproofing.
9. ASTM D 312- Standard Specification for Asphalt Used in Roofing.
10. ASTM D 1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
11. ASTM D 2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
12. ASTM D 3019 - Standard Specification for Lap Cement Used with Asphalt Roll Roofing, Non-Fibered, Asbestos-Fibered, and Non-Asbestos-Fibered.
13. ASTM D 3746 - Standard Test Method for Impact Resistance of Bituminous Roofing System.
14. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
15. ASTM D 4601 - Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
16. ASTM D 5147 - Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
17. ASTM D 5849 - Standard Test Method for Evaluating Resistance of Modified Bituminous Roofing Membrane to Cyclic Fatigue (Joint Displacement)
18. ASTM D 6162 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
19. ASTM D 6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
20. ASTM D 6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
21. ASTM D 6298 - Standard Specification for Fiberglass Reinforced Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface.
22. ASTM D 7379 - Standard Test Methods for Strength of Modified Bitumen Sheet Material Laps Using Cold Process Adhesive.
23. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
24. ASTM E 1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

C. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)::
1. ANSI/SPRI/FM 4435/ES-1 Wind Design Standard for Edge System Used with Low Slope Roofing System.

2. ANSI/SPRI FX-1, Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.
3. ANSI/SPRI IA-1, Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives over Various Substrates.
4. ANSI/FM 4474- American National Standard for Evaluating the Simulated Wind Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures.

D. FACTORY MUTUAL (FM):
1. FM 4450 - Approval Standard - Class I Insulated Steel Roof Decks.
2. FM 4470 - Approval Standard - Class I Roof Covers.

E. BUILDING CODES:
1. Florida Building Code, 2010 edition.

F. NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA).

G. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION INC. (SMACNA) Architectural Sheet Metal Manual.

H. UNDERWRITERS LABORATORY (UL):
1. UL 790 Standard Test Methods for Fire Tests of Roof Coverings.
2. UL 1256 – Fire Test of Roof Deck Constructions.

1.06 ACTION SUBMITTALS

A. Product Data Sheets: Submit manufacturer's product data sheets, installation instructions and/or general requirements for each component.

B. Sample/Specimen Warranty from the manufacturer and contractor.

C. Shop Drawings: Provide roof plan and applicable roof system detail drawings.

1.07 INFORMATIONAL SUBMITTALS

A. Contractor Certification: Submit written certification from roofing system manufacturer certifying that the applicator is authorized by the manufacturer to install the specified materials and system.

1.08 CLOSEOUT SUBMITTALS

A. Warranty: Provide manufacturer's and contractor's warranties upon substantial completion of the roofing system.

1.09 QUALITY ASSURANCE

A. MANUFACTURER QUALIFICATIONS:
1. Manufacture shall have 20 years of experience manufacturing SBS-modified bitumen roofing materials.

2. Trained Technical Field Representatives, employed by the manufacturer, independent of sales.
3. Provide reports in a timely manner of all site visit reports.
4. Provide specified warranty upon satisfactory project completion.

B. CONTRACTOR QUALIFICATIONS:
1. Contractor shall be authorized by the manufacturer to install specified materials prior to the bidding period through satisfactory project completion.
2. Applicators shall have completed projects of similar scope using same materials as specified herein.
3. Contractor shall provide full time, on-site superintendent or foreman experienced with the specified roof system through satisfactory project completion.
4. Applicators shall be skilled in the application methods for all materials.
5. Contractor shall maintain a daily record, on-site, documenting material installation and related project conditions.
6. Contractor shall maintain a copy of all submittal documents, on-site, available at all times for reference.

1.10 DELIVERY, STORAGE AND HANDLING

A. Refer to each product data sheet or other published literature for specific requirements.

B. Deliver materials and store them in their unopened, original packaging, bearing the manufacturer's name, related standards, and any other specification or reference accepted as standard.

C. Protect and store materials in a dry, well-vented, and weatherproof location. Only materials to be used the same day shall be removed from this location. During cold weather, store materials in a heated location, removed only as needed for immediate use.

D. When materials are to be stored outdoors, store away from standing water, stacked on raised pallets or dunnage, at least 4 in or more above ground level. Carefully cover storage with “breathable” tarpaulins to protect materials from precipitation and to prevent exposure to condensation.

E. Carefully store roof membrane materials delivered in rolls on-end with selvage edges up. Store and protect roll storage to prevent damage.

F. Properly dispose of all product wrappers, pallets, cardboard tubes, scrap, waste, and debris. All damaged materials shall be removed from job site and replaced with new, suitable materials.

1.11 SITE CONDITIONS

A. SAFETY:
1. The contractor shall be responsible for complying with all project-related safety and environmental requirements.
2. Heat-welding shall include heating the specified membrane ply using propane roof torches or electric hot-air welding equipment. The contractor shall

determine when and where conditions are appropriate to utilize heat-welding equipment. When conditions are determined by the contractor to be unsafe to proceed, equivalent SBS-modified bitumen materials and methods shall be utilized to accommodate requirements and conditions.

3. Refer to NRCA CERTA recommendations, local codes and building owner's requirements for hot work operations.
4. The contractor shall review project conditions and determine when and where conditions are appropriate to utilize the specified liquid-applied, or semi-solid roofing materials. When conditions are determined by the contractor to be unsafe or undesirable to proceed, measures shall be taken to prevent or eliminate the unsafe or undesirable exposures and conditions, or equivalent approved materials and methods shall be utilized to accommodate requirements and conditions.
5. The contractor shall review project conditions and determine when and where conditions are appropriate to utilize the specified hot asphalt-applied materials. When conditions are determined by the contractor to be unsafe or undesirable to proceed, measures shall be taken to prevent or eliminate the unsafe or undesirable exposures and conditions, or equivalent approved materials and methods shall be utilized to accommodate requirements and conditions. .
6. The contractor shall refer to product Material Safety Data Sheets (MDS) for health, safety, and environment related hazards, and take all necessary measures and precautions to comply with exposure requirements.

B. ENVIRONMENTAL CONDITIONS:

1. Monitor substrate temperature and material temperature, as well as all environmental conditions such as ambient temperature, moisture, sun, cloud cover, wind, humidity, and shade. Ensure conditions are satisfactory to begin work and ensure conditions remain satisfactory during the installation of specified materials. Materials and methods shall be adjusted as necessary to accommodate varying project conditions. Materials shall not be installed when conditions are unacceptable to achieve the specified results.
2. Precipitation and dew point: Monitor weather to ensure the project environment is dry before, and will remain dry, during the application of roofing materials. Ensure all roofing materials and substrates remain above the dew point temperature as required to prevent condensation and maintain dry conditions.
3. Mopping asphalt application: Primer, where used, shall be fully dry before applying hot asphalt. Take all necessary measures and monitor all conditions, to ensure the specified asphalt temperature is no less than 400°F (204°C) at the point of contact with the specified membrane as it is rolled into the hot asphalt.
4. Cold adhesive application: Primer, where used, shall be fully dry before proceeding. During cold weather, store the specified membrane adhesives, flashing cements and mastics in heated storage areas. Take all necessary measures and monitor application conditions, to ensure the adhesive and cement materials are no less than 70°F (21°C) at the point of contact with the membrane.

5. Self-adhered membrane application: During cold weather, store the specified self-adhered membrane and primer materials in heated storage areas to ensure materials remain no less than 70°F (21°C) during application. Ensure conditions allow primer to remain tacky, but not wet so that primer will transfer to finger when touched. Self-adhered primer should not fully dry and lose tack before applying the self-adhered membrane. Ensure conditions remain satisfactory to achieve membrane adhesion as specified.
6. Heat-Welding Application: Take all necessary precautions and measures to monitor conditions to ensure all environmental conditions are safe to proceed with the use of torches and hot-air welding equipment. Combustibles, flammable liquids and solvent vapors that represent a hazard shall be eliminated and primers shall be fully dry before proceeding with heat-welding operations. Refer to NRCA CERTA recommendations.

1.12 PERFORMANCE REQUIREMENTS

A. WIND UPLIFT RESISTANCE:
1. Performance testing shall be in accordance with ANSI/FM 4474, FM 4450, FM 4470, UL 580 or UL 1897.
a. Roof System Design Pressures: Calculated in accordance with ASCE 7, or applicable standard, for the specified roof system attachment requirements:
i. Refer to structural drawings for requirements.

B. FIRE CLASSIFICATION:
1. Performance testing shall be in accordance with UL 790, ASTM E108, FM 4450 or FM 4470.
a. Meets requirements of UL Class A or FM Class A.
2. Performance testing shall be in accordance with UL 1256, FM 4450 or FM 4470 to meet the specified requirements for interior flame spread and fuel contribution.
a. Meets requirements of UL 1256, or FM Class 1.

C. ROOF SLOPE:
1. Finished roof slope for SBS modified bitumen surfaces shall be ¼ inch per foot (2 percent) minimum for roof drainage or as required by code.

D. IMPACT RESISTANCE:
1. Performance testing for impact resistance shall be in accordance with FM 4450, FM 4470, ASTM D3746 or CGSB 37-GP 56M to meet the specified impact resistance requirements.
a. Meets requirements for FM-SH (Severe Hail), ASTM D3746, or CGSB 37-GP 56M.

E. LEED SUSTAINABLE SITES (SS) CREDITS:
1. SS 7.2, Heat Island Effect-Roof. Cap sheet shall be surfaced with highly reflective mineral granules. (SOPREMA SG Granule surfacing basis of design):

a. Seventy-five percent of the low-slope roof area shall have an SRI value greater than, or equal to, 78 as published by the Cool Roof Rating Council (CRRC).

F. ENERGY-STAR RATING:

1. The roof membrane shall meet the approval requirements of the US EPA EnergyStar Program. Cap sheet shall be surfaced with highly reflective, factory-applied, tri-laminate film surfacing. (SOPREMA Soprastar cap sheet basis of design):

a. Membrane Cap Sheet shall be an EnergyStar Approved Product.

i. Solar Reflectance: Initial: 0.78 3-year: 0.74

ii. Thermal Emittance: Initial: 0.89 3-year: 0.66

G. ROOF EDGE SYSTEM SECUREMENT:

a. Performance testing in accordance with ANSI/SPRI ES-1.

b. Performance testing meets requirements for specified roof system design pressures.

1.13 WARRANTY

A. Manufacturer's No Dollar Limit (NDL), Labor and Material Warranty. The manufacturer shall provide the owner with the manufacturer's labor and material warranty covering products and contractor workmanship for 20 years from the date the warranty is issued.

B. The contractor shall guarantee the workmanship and shall provide the owner with the contractor's warranty covering workmanship for a period of 3 years from Substantial Completion date.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. SINGLE SOURCE MANUFACTURER: All SBS modified bitumen membrane and flashing sheets shall be manufactured by a single supplier with 20 years or more manufacturing history in the US.

B. PRODUCT QUALITY ASSURANCE PROGRAM: Manufacturer shall be an ISO 9001 registered company. A 'Quality Compliance Certificate (QCC) for reporting/confirming the tested values of the SBS-Modified Bitumen Membrane Materials will be supplied upon request.

C. ACCEPTABLE MANUFACTURER:

1. SOPREMA, located at: 310 Quadral Dr.; Wadsworth, OH 44281; Tel: 800-356-3521; Tel: 330-334-0066; Website: www.soprema.us.

2.02 ROOFING SYSTEM

A. ROOFING SYSTEM BASIS OF DESIGN: SOPREMA

2.03 SBS-MODIFIED BITUMEN MEMBRANES

A. BASE PLY/FLASHING BASE PLY

1. BASE PLY/FLASHING BASE PLY, HEAT-WELDED:

2. BASE PLY/ FLASHING BASE PLY, HEAT-WELDED, PARTIALLY ADHERED:

a. SOPREMA Colvent Flam 180 TG: SBS-modified bitumen membrane ply with 1 in wide factory-applied, heat activated bitumen strips on the underside and a plastic burn-off film top surface. Non-woven polyester reinforced.

i. Thickness: 120 mils (3.0 mm)

ii. Width: 39.4 in (1 m)

iii. Length: 32.8 ft (10 m)

iv. Meets or exceeds ASTM D6164, Type I, Grade S.

B. CAP SHEET/FLASHING CAP SHEET:

1. CAP SHEET/ FLASHING CAP SHEET, HEAT-WELDED:

a. SOPREMA Soprastar Flam: SBS-modified bitumen membrane Cap Sheet, with a burn-off film bottom surface and highly reflective, film top surface. Composite glass fiber and non-woven polyester reinforced. UL Class A for specified roof slope requirements.

i. Thickness: 138 mils (3.5 mm)

ii. Width: 39.4 in (1 m)

iii. Length: 32.8 ft (10 m)

iv. Meets or exceeds ASTM D6162, Type I, Grade S.

v. Highly reflective film surfacing, listed by the Cool Roof Rating Council (CRRC):

a) Solar Reflectance: Initial: 0.78 3-year: 0.74

b) Thermal Emittance: Initial: 0.89 3-year: 0.66

c) Solar Reflectance Index (SRI): Initial: 97 3-yr: 86

vi. EPA EnergyStar Certified Roofing Product:

a) Emittance: Initial: 0.89

2.04 ACCESSORIES

A. PRIMERS:

1. SOPREMA Elastocol 500 Primer: Asphalt cut-back primer. Primer for the preparation of roof membrane and flashing substrates for asphalt, heat-welded, hot asphalt and cold adhesive-applied applications.

a. Meets or exceeds ASTM D41

b. VOC content: 350 g/L or less.

B. GENERAL PURPOSE ROOFING CEMENT AND MASTIC

1. SOPREMA Sopramastic: SBS Mastic. Fiber-reinforced, roofing cement, packaged in 5 gallon pails. General purpose roofing cement for low-slope roofing used for sealing membrane T-joints and membrane edges along terminations, transitions and at roof penetrations.
    a. VOC Content: 190 g/L or less.
    b. Meets or exceeds ASTM D4586, Type I, Class II.
2. SOPREMA Sopramastic: SBS Mastic. Fiber-reinforced, roofing cement, packaged in 10.4 oz caulk tubes. General purpose roofing cement for low-slope roofing used for sealing membrane T-joints and membrane edges along terminations, transitions and at roof penetrations.
    a. VOC Content: 190 g/L or less.
    b. Meets or exceeds ASTM D4586, Type I, Class II.

C. GENERAL PURPOSE SEALANT
1. SOPREMA Sopramastic SP1: General purpose, gun-grade, elastomeric sealant for sealing vertical joints/cracks.
    a. VOC Content: 20 g/L or less.
    b. Meets or exceeds ASTM C920, Type S, Grade NS, Class 50.

D. SURFACE FINISH
1. SOPREMA Alsan Finish Alsan Finish LO (Low Odor): Bright white, two-component, liquid resin, un-reinforced surface finish. Soprastar membrane touch-up and film surface restoration.
    a. Meets UL Class A when applied to specified roofing system.
    b. Application Rate: 1.0 gallon per square minimum.

E. EXPANSION JOINT:
1. SOPREMA Soprajoint: Low-profile, polyester knit-reinforced, SBS-modified bitumen expansion joint membrane. Top surface consists of an aluminum-clad bond-breaker, with plastic burn-off film on the bottom surface for torch or hot air welding.
    a. Thickness: 160 mils (4.0 mm)
    b. Width: 18 in (457 mm)
    c. Roll Length: 32.8 ft (10 m)
    d. Expansion joint, maximum unsupported span: 2 in (51 mm)
    e. Expansion joint, maximum displacement: 5/8 in (16 mm)

F. SHEET METAL FLASHING:
1. Contractor shall furnish all sheet metal flashings, counter flashings, roof edge system, and all other related sheet metal flashings and associated fasteners necessary to flash and counter flash the specified roofing system.
2. Sheet metal flashing materials and fasteners shall be compatible with adjacent materials, to accommodate all project related exposures.
3. Pre-Finished (Mill Finished) Sheet Metal Flashing Material: Aluminum.
4. Roof Edge System: Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.

G. SHEET METAL, ROOF EDGE SYSTEM:

1. Roof edge system shall include all components and associated fasteners included by the manufacturer to comply with specified performance requirements. Contractor shall provide all other related fasteners and sealants not provided as part of the roof edge system, and required in the manufacturer's product data sheets.
2. SOPREMA SopraCap/SopraCap Plus Parapet Coping, Hickman Engineered System, PermaSnap/PermaSnap Plus: Engineered metal coping with hold-down cleats.
   a. Material: Aluminum, Galvanized Steel
   b. Gauge/Thickness: 0.050, 0.063 in aluminum, 24 gauge steel
   c. Cleat: Galvanized Steel (SopraCap: 20 gauge-FM 1-90) (SopraCap Plus: 16 gauge-FM 1-180)
   d. Finish: Kynar 500 Color selected from manufacturer's color chart. Mill-Finished Aluminum.
   e. Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.
   f. FM Approved.
3. SOPREMA SopraEdge Extruded Roof Edge, Hickman Engineered System, Extruded Terminedge for BUR & MOD BIT: Engineered two-piece fascia system with an extruded aluminum retainer base plate and a formed metal fascia.
   a. Material: Aluminum, Galvanized Steel
   b. Gauge/Thickness: 0.040, 0.050, 0.063 in aluminum, 24 gauge steel
   c. Base: 0.100 in extruded aluminum
   d. Finish: Kynar 500 Color selected from manufacturer's color chart. Mill-Finished Aluminum.
   e. Tested per ANSI/SPRI ES-1 to meet or exceed design pressures at roof edge.
   f. FM Approved.
4. SOPREMA SopraSpan Expansion, Hickman Engineered System, Permaspan Roof Expansion Joint, (Roof/Roof-to-Wall) Expansion Joint: Engineered, formed metal expansion joint cover with a continuous articulating anchor cleat.
   a. Material: Aluminum, Galvanized Steel
   b. Gauge/Thickness: 0.050, 0.063 in aluminum, 24 gauge steel
   c. Cleat: 20 gauge Galvanized steel.
   d. Finish: Kynar 500 Color selected from manufacturer's color chart. Mill-Finished Aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examination includes visual observations, qualitative analysis, and quantitative testing measures as necessary to ensure conditions remain satisfactory throughout the project.

B. The contractor shall examine all roofing substrates including, but not limited to: insulation materials, roof decks, walls, curbs, rooftop equipment, fixtures, and wood blocking.

C. The applicator shall not begin installation until conditions have been properly examined and determined to be clean, dry and, otherwise satisfactory to receive specified roofing materials.

D. During the application of specified materials, the applicator shall continue to examine all project conditions to ensure conditions remain satisfactory to complete the specified roofing system.

3.02 PREPARATION

A. Before commencing work each day, the contractor shall prepare all roofing substrates to ensure conditions are satisfactory to proceed with the installation of specified roofing materials. Preparation of substrates includes, but is not limited to, substrate repairs, securement of substrates, eliminating all incompatible materials, and cleaning.

B. Where conditions are found to be unsatisfactory, work shall not begin until conditions are made satisfactory to begin work. Commencing of work shall indicate contractor's acceptance of conditions.

3.03 PRIMER APPLICATION

A. Apply the appropriate specified primer to dry, compatible substrates as required to enhance adhesion of new specified roofing materials.

B. Apply primer using brush, roller, or sprayer at the rate published on the product data sheet.

C. Fully prime substrates using brush, roller, or sprayer at the application rate published in the product data sheet

D. Asphalt Primer: Apply ELASTOCOL 500 primer to dry compatible masonry, metal, wood and other required substrates before applying asphalt and heat-welded membrane plies. Primer is optional for most solvent based solvent-based SBS adhesives and cements, refer to product data sheets.

E. Project conditions vary throughout the day. Monitor changing conditions, monitor the drying time of primers, and monitor the adhesion of the membrane plies. Adjust primer and membrane application methods as necessary to achieve the desired results.

3.04 HEAT WELDING

A. The Contractor is responsible for project safety. Where conditions are deemed unsafe to use open flames, manufacturer's alternate membrane application methods shall be used to install SBS modified bitumen membrane and flashings. Acceptable alternate installation methods include hot asphalt, cold adhesive-applied, self-adhered membranes and mechanically fastened plies. Hot-air welding equipment may be used in lieu of roof

torches to seal membrane side and end laps where heat welding the laps is necessary. Refer to NRCA CERTA, local codes and building owner's requirements for hot work operations.

B. Single or multi-nozzle, hand-held propane roof torches shall be used to install heat-welded membrane and flashing plies. Multi-nozzle carts (dragon wagons) may also be utilized to install membrane plies. Seven (7) nozzle carts are recommended for more uniform heat application in lieu of five (5) nozzle carts.

3.05 SBS MASTIC AND GENERAL PURPOSE ROOFING CEMENT APPLICATION

A. Apply general purpose SBS mastic and roofing cement to seal drain leads, metal flanges, seal along membrane edge at terminations, and where specified and required in detail drawings.

B. Do not use general purpose SBS mastics and roofing cement where flashing cement applications are required. Do not use SBS mastics and roofing cement beneath SBS-modified bitumen membrane and flashing plies.

C. Apply general purpose SBS mastic and elastic roofing cement using caulk gun, or notched trowel at 2.0 – 2.5 gallons per square on each surface. Application rates vary based on substrate porosity and roughness. Tool-in as necessary to seal laps

D. Embed matching granules into wet cement where exposed.

3.06 MECHANICALLY FASTENED ANCHOR/BASE SHEET APPLICATION

A. Follow material product data sheets and published general requirements for installation instructions.

B. Ensure environmental conditions are satisfactory, and will remain satisfactory, during the application of the sheet.

C. Unroll the membrane onto the roof surface. Allow the sheet to relax prior to installing the fasteners.

D. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps.

E. Cut rolls to working lengths as required conforming to roof conditions. .

F. Align sheet at side-laps to produce a consistent overlap required for wind uplift resistance approvals.

G. As uniform tension is being applied, fasten the sheet beginning at the center of the sheet and work towards the end-laps, removing all wrinkles and buckles as fastening progresses.

H. Install specified base sheet fasteners along the center line of side-laps, and intermediate rows staggered between side-laps, and fasten all end-laps.

I. Fasten base sheet as required for specified wind uplift resistance. Install additional fasteners in roof perimeter and corners as specified.

3.07 HEAT-WELDED, FULLY ADHERED MEMBRANE APPLICATION

A. Follow material product data sheets and published general requirements for installation instructions.

B. Ensure environmental conditions are satisfactory, and will remain satisfactory, during the application of the heat-welded membrane.

C. Ensure all primers are fully dry before beginning heat-welding operations.

D. Unroll membrane onto the roof surface and allow to relax prior to installing the membrane.

E. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps.

F. Ensure all roofing and flashing substrates are prepared and acceptable to receive the heat-welded membrane.

G. Cut rolls to working lengths to conform to roof conditions, and lay out to always work to a selvage edge.

H. Ensure specified side-laps and end-laps are maintained. End-laps should be staggered 3 ft apart.

I. As the membrane is un-rolled, apply heat to the underside of the membrane until the plastic burn-off film melts away. Continuously move the torch back-and-forth across the underside of the roll to melt the bitumen on the underside of the sheet, while continuously unrolling sheet.

J. While unrolling and heating the sheet, ensure a constant flow hot bitumen approximately ¼ to 1/2 in flows ahead of the roll as it is unrolled, and there is 1/8 to 1/4 in bleed out at all laps.

K. Adjust the application of heat to the underside of the membrane and to substrate as required for varying substrates and environmental conditions.

L. At the 6 in end-laps, melt the plastic burn-off film from the top surface or embed granules, where present, using a torch or hot-air welder.

M. At end-laps, cut a 45 degree dog-ear away from the selvage edge, or otherwise ensure the membrane is fully heat-welded watertight at all T-joints.

N. Each day, physically inspect all side and end-laps, and ensure the membrane is sealed watertight. Where necessary, use a torch or hot-air welder and a clean trowel to ensure all laps are sealed.

O. Inspect the installation each day to ensure the plies are fully adhered. Repair all voids, wrinkles, open laps and all other deficiencies.

P. Offset cap sheet side and end-laps away from the base ply laps so that Cap Sheet laps are not located within 18 in of base ply laps.

3.08 HEAT-WELDED, PARTIALLY-ADHERED MEMBRANE APPLICATION

A. Follow material product data sheets and published general requirements for installation instructions.

B. Where partially-adhered membrane base ply is designed to vent vapor pressure, ensure the membrane base ply and flashings are installed to allow the venting channels on the underside of the membrane base ply to remain un-obstructed for venting pressure.

C. Ensure environmental conditions are satisfactory, and will remain satisfactory, during the application of the partially-adhered, heat-welded membrane.

D. Ensure all primers are fully dry before beginning heat-welding operations

E. Adhesion Testing: Before beginning membrane application, the applicator shall ensure conditions and torch methods are satisfactory to proceed.

1. Inspect the substrate to ensure substrate is primed and primer is dry.
2. Cut a 6 ft long membrane specimen from a roll.
3. Heat-weld the membrane specimen to the primed substrate, leaving a 6 in "dry tail" un-adhered.
4. Allow the membrane to cool to ambient temperature.
5. Attempt to peel the membrane from the substrate by pulling upward on the "dry tail."
6. Observe results to verify conditions and methods result in proper adhesion.

F. Unroll membrane onto the roof surface and allow to relax prior to installing the membrane.

G. Starting at the low point of the roof, lay out the membrane to ensure the plies are installed perpendicular to the roof slope, shingled to prevent back-water laps.

H. Ensure all roofing and flashing substrates are prepared and acceptable to receive the heat-welded membrane.

I. Cut rolls to working lengths to conform to roof conditions, and lay out to always work to a selvage edge.

J. In order to maintain the venting pattern on the underside of the membrane, the membrane shall be butted at each end, and the end joint shall be stripped-in using a fully-adhered heat-welded, strip-in ply, not overlapped.

K. As the membrane is un-rolled, apply heat to the underside of the membrane until the plastic burn-off film melts away from the ribbons of bitumen. Direct the torch high on the roll as required to prevent lifting the sheet.

L. Continuously move the torch back-and-forth across the underside of the roll as required melt the bitumen ribbons on the underside of the sheet while not melting the sanded bitumen between ribbons.

M. While unrolling and heating the membrane, ensure the melted bitumen ribbons maintain contact with the substrate as necessary to adequately adhere the ribbons to the substrate.

N. Adjust the application of heat as required for varying substrates and environmental conditions.

O. At membrane terminations, ensure the venting pattern is maintained as required to continue the venting pattern to adjacent flashing details.

P. At all side-laps, ensure side-laps are heat-welded across the full width, and there is approximately 1/8 to 1/4 in bleed-out.

Q. Each day, physically inspect all side and end-laps, and ensure the membrane is sealed watertight. Where necessary, use a torch or hot-air welder and a clean trowel to ensure all laps and T-joints are sealed watertight.

R. Inspect the installation each day to ensure the plies are sufficiently adhered. Repair all un-adhered areas, wrinkles, open laps and all other deficiencies.

S. Offset Cap Sheet side and end-laps away from the base ply laps so that Cap Sheet laps are not located within 18 in of base ply laps.

3.09 FLASHING APPLICATION, HEAT WELDED

A. Refer to SBS manufacturer's membrane application instructions, flashing detail drawings, and follow product data sheets and other published requirements for installation instructions. Refer to manufacturer's membrane flashing detail drawings.

B. The contractor is responsible for project safety. Refer to NRCA CERTA recommendations and building owner requirements for hot work operations.

C. Where required to seal substrates for fire safety, install specified adhered, self-adhered or fastened backer ply to the substrate. Ensure backer-ply covers and seals all substrates requiring protection from exposure to torch operations.

D. Ensure all flashing substrates that require primer are primed, and the primer is fully dry.

E. Unroll the flashing base ply and flashing Cap Sheet onto the roof surface to their complete length. Once relaxed, cut the membrane to the required working lengths to accommodate the flashing height, cants and the required over-lap onto the horizontal roof surface.

F. Cut the flashing membrane from the end of the roll in order to always install flashings to the side-lap line or selvage edge line.

G. Lay out the flashing base ply and flashing Cap Sheet to offset all side-laps a minimum of 12 inches so that side-laps are never aligned on top of the ply beneath. Shingle the flashing ply laps to prevent back-water laps.

H. Install non-combustible cant strips at transitions where required.

I. Ensure correct membrane and flashing sequencing to achieve redundant, multi-ply, watertight flashings.

J. ROOF MEMBRANE BASE PLY:

1. Before installing flashings, install the roof membrane base ply in the horizontal field of the roof, and extend the base ply up to the top of the cant, where present, at roof terminations, transitions and penetrations.

K. FLASHING BASE PLY:

1. Install the flashing base ply starting at the top leading edge of the vertical flashing substrate, down over the cant and onto the horizontal surface of the roof a minimum of 3 inches beyond the of base of the cant. Cut the base ply at corners to form 3 inch side-laps. Install gussets to seal corner transitions.
2. Install one or more flashing base ply(s) at all roof terminations, transitions and penetrations.

L. ROOF MEMBRANE CAP SHEET:

1. Install the roof membrane Cap Sheet in the horizontal field of the roof over the flashing base ply up to the roof termination, transition or penetration, and up to the top of cants where present.
2. Using a chalk line, mark a line on the membrane Cap Sheet a minimum of 4 inches from the base of the cant onto the roof. Where granules are present,

embed the Cap Sheet granules using a torch and trowel or granule embedder to prepare the surface to receive the flashing Cap Sheet.

M. FLASHING CAP SHEET:

1. Install the flashing Cap Sheet starting at the top leading edge on the vertical substrate, over the cant and onto the roof surface 4 inches from the base of the cant.
2. Install the flashing Cap Sheet to ensure a minimum two (2) ply flashing system is present at all roof terminations, transitions and penetrations.

N. During the membrane and flashing installation, ensure all plies are completely adhered into place, with no bridging, voids or openings. Ensure bitumen or flashing cement bleed-out is present at all flashing side and end-laps.

O. Use a damp sponge float or damp rag to press-in the heat-welded flashing plies during installation.

P. Where sufficient bitumen bleed-out is not present, and for all self-adhered plies, apply specified gun-grade sealant or mastic to seal the membrane termination along all roof terminations, transitions and penetrations. These include gravel stop edge metal, pipe penetrations, along the top edge of curb and wall flashing, and all other flashing terminations where necessary to seal flashings watertight.

Q. Fasten the top leading edge of the flashing 8 in on-centers with appropriate 1 in cap nails or other specified fasteners. Seal fastener penetrations watertight using specified sealant or mastic.

R. Manufacturer's liquid-applied, reinforced flashing systems shall be installed where conditions are not favorable to install SBS modified bitumen flashings. Such conditions include irregular shapes penetrating roof surfaces (I-beams), confined areas and low flashing heights. Manufacturer's liquid-applied, reinforced flashing systems are recommended in lieu of pitch pans and lead pipe flashings. Refer to manufacturer's installation guidelines (SOPREMA ALSAN FLASHING AND ALSAN RS).

3.10 PARTIALLY-ADHERED FLASHINGS

A. Refer to partially-adhered membrane application instructions.

B. Where specified, ensure partially-adhered flashings that are designed to vent pressure to the atmosphere are adhered at all adhesive ribbons on the underside of the flashing base ply. The sanded vent channels should remain un-adhered to the substrate.

C. Install the membrane base ply and flashing base ply to ensure the vent channel pattern is maintained and free to vent pressure to the flashing termination.

D. Butt the end of the base flashing sheet to the membrane base ply sheet. Strip-in the butted joint using a 6 inch wide, fully-adhered strip-in ply to seal the butted joints watertight.

E. At the end of each work day, ensure the open vent channels at the end of the sheet are not left exposed to precipitation or other moisture infiltration. The open venting channels must be protected from moisture infiltration during construction. Temporary night seals should be installed as required to seal flashing end terminations watertight. Temporary night seals should be removed upon resuming the installation to ensure venting channels are maintained as specified.

F. The completed venting flashed must be counter flashed watertight to prevent moisture infiltration into the venting channels.

3.11 LIQUID-APPLIED, SINGLE-COMPONENT, BITUMEN-URETHANE FLASHING SYSTEM APPLICATION:

A. Refer to manufacturer's details drawings, product data sheets and published general requirements for application rates and specific installation instructions
B. Pre-cut polyester reinforcing fleece to conform to roof terminations, transitions and penetrations being flashed. Ensure a minimum 2 in overlap of fleece at side and end-laps. Ensure the completed liquid-applied flashing membrane is fully reinforced.
C. Apply the base coat of liquid-applied flashing resin onto the substrate using a brush or roller, working the material into the surface for complete coverage and full adhesion.
D. Immediately apply the reinforcing into the wet base coat of resin. Using a brush or roller, work the into the wet resin while applying the second coat of resin to completely encapsulate the fleece.
E. Allow the liquid membrane to sufficiently cure for 24 to 48 hours, then apply the finish coat of resin.
F. Broadcast mineral granules into the wet finish coat as required to match the adjacent cap sheet.
G. For SOPREMA Soprastar cap sheets, allow the system to completely cure for 48 hours or more, then apply the liquid-applied surfacing to match the adjacent Soprastar cap sheet. Refer to SOPREMA ALSAN FINISH product data sheets and installation instructions.

3.12 LIQUID-APPLIED, PMMA (PMA) MEMBRANE AND FLASHING SYSTEM APPLICATION (ALSAN RS ALSAN RS LO)

A. Refer to manufacturer's details drawings, product data sheets and published general requirements for application rates and specific installation instructions.
B. Pre-cut polyester reinforcing fleece to conform to roof terminations, transitions and penetrations being flashed. Ensure a minimum 2 in overlap of fleece at side and end-laps. Ensure the completed liquid-applied flashing membrane is fully reinforced.
C. Apply the base coat of catalyzed resin onto the substrate using a brush or roller, working the material into the surface for complete coverage and full adhesion.
D. Immediately apply the reinforcing into the wet base coat of resin. Using a brush or roller, work the reinforcing fabric into the wet resin while applying the second coat of catalyzed resin to completely encapsulate the fleece.
E. Refer to reinforced, polymethyl-methacrylate (PMMA) specification section and application instructions, details drawings, product data sheets and published general requirements for installation instructions.

3.13 SHEET METAL FLASHING APPLICATION

A. Refer to sheet metal flashing detail drawings, and follow product data sheets and published general requirements for installation instructions.
B. Follow the most recent edition of the SMACNA Architectural Sheet Metal Manual for fabrication and installation requirements.

3.14 WALKWAYS

A. At areas outlined on the drawings, and around the perimeter of all rooftop equipment and at all door and stair landings, install walkway protection.
B. Cut walkway from end of rolls. No piece shall be less than 24 in.
C. Provide a 2 in space between sheets for drainage.

3.15 CLEAN-UP

A. Clean-up and properly dispose of waste and debris resulting from these operations each day as required to prevent damages and disruptions to operations.

END OF SECTION 075217

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Reglets and counterflashings.

B. Preinstallation Conference: Conduct conference at Project site.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and pressure.

1.5 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075216 and 075217 SBS Roofing Systems.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: Minimum 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.

B. FM Approvals' Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 10 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Architectural Products Company.
    b. Hickman Company, W. P.
    c. Metal-Fab Manufacturing, LLC.
    d. Petersen Aluminum Corporation.

2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.040 inch thick.

    a. Surface: Smooth, flat finish.
    b. Finish: Mill or clear anodic finish.

3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
b. Face-Leg Cleats: Concealed, continuous stainless steel.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Products Company.
2. Hickman Company, W. P.
3. Metal-Fab Manufacturing, LLC.
4. Architects approved substitution.

B. Downspouts: Plain rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Formed Aluminum: 0.040 inch thick.

C. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout and built-in overflow.
1. Formed Aluminum: 0.04 inch thick minimum.

D. Aluminum Finish: Mill or Clear anodic finish.

2.4 REGLETS AND COUNTERFLASHINGS

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. Fry Reglet Corporation.
2. Hickman Company, W. P.
3. Metal-Fab Manufacturing, LLC.
4. Architects approved manufacturer.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Formed Aluminum: 0.024 inch thick.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.
3. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Multiuse Type, Embedded: For multiuse embedment in cast-in-place concrete.

C. Accessories:
1. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

D. Aluminum Finish: Mill or Clear anodic finish.

2.5 MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.7 FINISHES

A. Coil-Coated Aluminum Sheet Finishes:

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.2 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.3 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.4 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

C. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

D. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below scupper discharge.

3.5 REGLET AND COUNTERFLASHING INSTALLATION

A. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Setion 092400 “Cement Plastering” for installation of reglets.

B. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

B. Shop Drawings: For roof accessories.

1.3 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded fastened and sealed corner joints, straight sides, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Curbs Plus, Inc.
b. Greenheck Fan Corporation.
c. Metallic Products Corp.
d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
e. Roof Curb Systems.
f. Vent Products Co., Inc.
g. Architects approved substitution.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, minimum 0.052 inch thick.

1. Finish: Factory prime coating.
2. Color: As selected by Architect from manufacturer's full range.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Fabricate curbs to minimum height of 18 inches above final roofing surface unless otherwise indicated.
3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
4. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
5. Liner: Same material as curb, of manufacturer's standard thickness and finish.
6. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
7. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
8. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.2 EQUIPMENT SUPPORTS

A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AES Industries, Inc.
b. Greenheck Fan Corporation.
c. Lloyd Industries, Inc.
d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
e. Roof Curb Systems.
f. Roof Products, Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, minimum 0.052 inch thick.

1. Finish: Factory prime coating.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers under top flange on side of curb, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 18 inches above finished roofing surface unless otherwise indicated.

2.3 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis.
b. Bilco Company (The).
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
e. Nystrom, Inc.
f. O'Keeffe's Inc.

B. Type and Size: Single-leaf lid, 30 by 36 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Aluminum sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated
2. Finish: Mill finish.

E. Construction:

1. Insulation: Glass-fiber board.

    a. R-Value: according to ASTM C 1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on sides that obstructs water flow.

F. Hardware: Spring operators, hold-open arm, galvanized spring latch with turn handles, galvanized butt- or pintle-type hinge system, and padlock hasps inside and outside.

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Finish: Manufacturer's standard.

    a. Color: Safety Yellow or as selected by Architect from manufacturer's full range.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078123 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings.

1.2 PREINSTALLATION MEETINGS

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

1. Schedule preinstallation conference to include the Owner, the Architect, and the Special Inspector, as well as any other impacted entity.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Evaluation reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. Installer must be able to show proficiency and a minimum of three current and consecutive years of experience in the type of work specified for the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. VOC Content: For field applications, coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. Mastic and Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed formulation, and complying with indicated fire-resistance design.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Albi Manufacturing; a division of StanChem, Inc.
b. Carboline Company; a subsidiary of RPM International.
c. Isolatek International.
d. Architects approved alternative that complies with project requirements.

2. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
4. Surface-Burning Characteristics: Comply with ASTM E 84.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

5. Finish: Spray-textured finish as selected by Architect from manufacturer's standard finishes.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer for the required fire-resistance design.

C. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

D. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

E. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.14, "Mastic and Intumescent Fire-Resistant Coatings." Or applicable Florida Building Code Requirements.

B. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

C. Prepare and submit test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Repair fireproofing damaged by other work before concealing it with other construction.

C. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Samples: For each kind and color of joint sealant proposed or required.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

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

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Sika Corporation; Joint Sealants.
c. Other Architects approved manufacturer meeting performance requirements.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. May National Associates, Inc.; a subsidiary of Sika Corporation.
b. Pecora Corporation.
c. Tremco Incorporated.
d. Other Architects approved manufacturer meeting performance requirements.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Control and expansion joints in unit masonry.
c. Other joints as indicated on Drawings.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors or to match adjacent surfaces.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.

c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As indicated by manufacturer's designations.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required.

F. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

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. Amweld International, LLC.

2. Ceco Door; ASSA ABLOY.
3. Curries Company; ASSA ABLOY.
4. Custom Metal Products.
5. Greensteel Industries, Ltd.
6. MPI Group, LLC (The).
7. Steelcraft; an Allegion brand.
8. Stiles Custom Metal, Inc.
9. Architects approved substitution meeting performance standards.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard.

3. Frames:

   a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.053 inch.
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Full profile welded.

4. Exposed Finish: Factory primed ready for field finish.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
    d. Edge Construction: Model 2, Seamless.
    e. Core: Polyurethane or polyisocyanurate.

3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than R-2.85 when tested according to ASTM C 1363.
4. Frames:

    a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
    b. Construction: Full profile welded.

5. Exposed Finish: Factory prime for field finish.

2.5 BORROWED LITES

A. Hollow-metal frames of metallic-coated steel sheet, minimum thickness of 0.042 inch.

B. Construction: Full profile welded.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Jamb Anchor Finish:
1. Where exposed heads remain after anchoring, head to be sanded and prepared for fully concealed finish appearance.

C. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.7 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).

J. Glazing: Section 088000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

2.8 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite and Transom Bar Frames: Where used, provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated. After installation is complete, grind, fill, finish, and paint.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

    c. Compression Type: Not less than two anchors in each frame.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: SDI A250.10.

B. Field Finish: SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 ACCESSORIES

A. Louvers: Provide sight proof louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Fire-Rated Automatic Louvers: Movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Install frames with removable stops located on secure side of opening.
    c. Install door silencers in frames before grouting.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory machining for hardware.

B. Related Requirements:
1. Section 087100 – Door Hardware.
2. Section 087400 – Door Access Control.
3. Section 088000 – Glazing for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
3. Product Data: For adhesives, indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

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. ABS- American Building Supply- Doormerica.
2. Algoma Hardwoods, Inc.
3. Ampco Products, LLC.
4. Eggers Industries.
5. General Veneer Manufacturing Co.
6. Ipik Door Company.
7. Mohawk Flush Doors, Inc.
8. Oshkosh Door Company.
9. VT Industries Inc.
10. Architects approved substitution meeting full performance requirements.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. Provide WI Certified Compliance Labels indicating that doors comply with requirements of grades specified.

B. Regional Materials: Wood doors shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

C. Regional Materials: Wood doors shall be manufactured within 500 miles of Project site.

D. Certified Wood: Wood doors shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-00 and FSC STD-40-004.

E. Adhesives: Do not use adhesives that contain urea formaldehyde.

F. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.

G. 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 positive pressure according to NFPA 252 or UL 10C]

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

H. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

I. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Select white birch.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Core: Structural composite lumber.
8. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
9. Construction: Seven plies, either bonded or nonbonded construction.

2.4 DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Faces: Any closed-grain hardwood of mill option.
3. Core: Structural composite lumber.
4. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
5. Construction: **Seven** plies, either bonded or nonbonded.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

B. Metal Louvers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Air Louvers Inc.; a Division of the Activar Construction Products Group.
   b. L & L Louvers, Inc.
   c. McGill Architectural Products.

2. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.

2.6 FABRICATION

A. Factory machine doors for hardware that is not surface applied.

B. Openings: Factory cut and trim openings through doors.

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 Section 088000 "Glazing." Field install where allowed.
3. Louvers: Factory install louvers in prepared openings.

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.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:

1. Grade: Premium.
2. Staining: As selected by Architect from manufacturer's full range.
3. Effect: Open-grain finish.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

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.

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.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

B. GC and subs are required to provide and install all access panels and doors affecting their trade at all locations necessary, whether indicated on the plans or not, to insure full, secure, and necessary access for maintenance and other purposes. Subs to coordinate among trades to insure no unnecessary duplication of access panels are installed.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Babcock-Davis.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Larsens Manufacturing Company.
   d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
   e. Nystrom, Inc.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall and ceiling.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Babcock-Davis.
   b. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
   c. JL Industries, Inc.; a division of the Activar Construction Products Group.
   d. Larsens Manufacturing Company.
   e. MIFAB, Inc.
   f. Milcor; Commercial Products Group of Hart & Cooley, Inc.
   g. Nystrom, Inc.

2. Description: Door face flush with frame, uninsulated; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Fire-Resistance Rating: Not less than that of adjacent construction, refer to drawings for requirements.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed for field finish.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-latching door hardware, operated by knurled-knob.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.6 FINISHES

A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Field Finished: Apply finish in field to match color and finish on adjacent surfaces. All exposed surfaces shall be professionally and sprayed to comply with building standard of care.

a. Color: Match adjacent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation, level, and plumb.

C. Prepare and provide at close-out an as-constructed plan indicating location and function of all installed access panels.

END OF SECTION 083113

SECTION 083313 - COILING PANTRY DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motorized Coiling doors at three Pantry rooms.

B. Related Requirements:

1. Division 26 for electrical requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment.
2. Show locations of controls, locking devices, power source and access, and other accessories.
3. Include diagrams for power, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 DOOR ASSEMBLY

A. Coiling Door: Coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Clopay Building Products.
    b. Cookson Company.
    c. Cornell Iron Works, Inc.
    d. Overhead Door Corporation.
    e. Raynor.
    f. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000.

C. Door Curtain Material: Aluminum.

D. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished to match door.

F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Aluminum.

    1. Mounting: As shown on Drawings.

H. Sill Configuration: No sill, door to reach floor.

I. Locking Devices: Door system is electric driven so no other locking device is needed.

J. Electric Door Operator:

    1. Usage Classification: Light duty, up to 10 cycles per hour.
    2. Motor Exposure: Interior.
    3. Emergency Manual Operation: Push-up type.
    4. Control Station(s): Exterior-side-mounted.

K. Curtain Accessories: Equip door with push/pull handles when power not working.

L. Door Finish:
    1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
    2. Factory Prime and Finish: Manufacturer's standard color.
    3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.2 MATERIALS, GENERAL

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.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
   2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.6 CURTAIN ACCESSORIES

A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a

spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

2.8 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Chamberlain Group, Inc. (The).

   b. Manufacturer' approved substitution.

2. Comply with NFPA 70.

3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics (coordinate with project requirements before order):

   a. Phase: Single phase.
   b. Volts: 208 V.
   c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated. Wall mount where indicated.

D. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

E. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pantry coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS - INTERIOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior Service doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 DOOR ASSEMBLY

A. Service Doors (142, and 148): Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Clopay Building Products.
b. Cookson Company.
c. Cornell Iron Works, Inc.
d. Overhead Door Corporation. 780 Series Basis-of-Design
e. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Curved profile slats of 1-7/8-inch center-to-center height.

E. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from aluminum extrusions and finished to match door.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish.

1. Mounting: As shown on Drawings.

H. Locking Devices: Equip door with slide bolt for padlock.

1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from outside only, with cylinder.

I. Manual Door Operator: Chain-hoist operator.

J. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum aluminum thickness of 0.032 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.6 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

C. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

2.7 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf.

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

END OF SECTION 083323

SECTION 083513 - FOUR-FOLD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 Work Included:

A. Provide all labor, equipment, materials and services required to execute and complete all items of work in connection with Furnishing and Installing the Four Fold Doors described herein. All work shall be in accordance with the specifications and drawings and result in a fully operating system.

B. Related Sections include:

1. Division 26 Section for Conductors and cables for electrical service and connections for powered operators and accessories.
2. Division 26 Section for disconnects switches and circuit breakers for powered operators.

1.3 SUMMARY

A. This Section includes Four-Fold metal doors, tested and approved for High Velocity Hurricane Zones, up to 100 psf and approved by Florida Building Code.

a. Refer to the drawings to confirm wind pressure requirements and provide additional fastening and engineering calculations, signed and sealed by a Florida Registered engineer, indicating compliance with project design requirements.

B. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators with single motor and gear box.

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 consisting of manufacturer’s technical Product Data and installation instructions for each type of door required, including data substantiating that products comply with requirements.

C. Submittal Drawings showing fabrication and installation of Four-Fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade

D. Submit structural calculations and other engineering data indicating compliance with project code and wind requirements. Submit additional fastening requirements to comply with all project requirements.

1.5 QUALITY ASSURANCE

A. Doors shall be designed to withstand external and internal horizontal wind loads as indicated on the drawings. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC “Steel Construction Manual”.

B. Operation-Cycle Requirements: Design four-fold door components and operator to operate for not less than 100,000 cycles.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.

B. Handle materials carefully to prevent damage.

1.7 WARRANTY

A. The door manufacturer shall provide a written standard limited warranty for material and workmanship of not less than one year from the date of Substantial completion.

B. The door manufacturer shall provide a written finish warranty for a minimum period of three (3) years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS – BASIS-OF-DESIGN

A. Manufacturers: Four-Fold industrial metal doors manufactured by Door Engineering and Manufacturing, 400 Cherry Street, Kasota, MN 56050, (800)-959-1352. Equal products by other manufacturers approved in advance, including FBC approval.

B. Alternate Manufacturer: Provide comparable products as manufactured by International Door, Inc. (734) 459-3000. Model #2011-FF-E-SOP.

2.2 MATERIALS

A. Steel Tube: ASTM A513 and ASTM A500/A500M

B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.

C. Hardware: Manufacturer’s standard components.

D. Fasteners: Zinc-coated steel.

2.3 FOUR-FOLD DOORS

A. Basis-of-Design Product: The drawings and specifications are based on the FF701 Series, Glazed or Solid Sheeted Four-Fold Doors as manufactured by Door Engineering and Manufacturing, LLC; Kasota, MN. Alternate approved substitution, meeting or exceeding all performance requirements are doors as manufactured by International Door, Inc., Kasota, MN.

B. Construction: Door framing shall be 11-gauge structural steel tube with 14-gauge sheet steel on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

C. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of TS6x6x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.

D. Factory finish: All exposed steel and other metal surfaces shall be finished with manufacturer's standard epoxy primer and polyurethane top coat. Color selected by the Architect, RAL # 3011.

E. Operating Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation. Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Jamb hinges shall be gusseted. Fold hinges shall be dual shear with two thrust bearings. Fold hinges shall be stainless steel. All bearings shall be completely sealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾" diameter hardened steel. All trolleys shall be equipped two (2) Nylatron rollers.

F. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive. No exposed fasteners shall be required to attach the weatherseals.

G. Perimeter Weatherstripping: Provide jamb and head weatherstipping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

H. Vision Panels: Provide 1 ¼" insulated glass (9/16" laminated safety glass, ½" airgap, ¼" tempered glass) vision panels of the size, shape and location as noted on the drawings.

I. Hurricane Locking System: Locking bolts shall be completely concealed within the door panel. Locking bolts shall extend into the floor and into the header tube. A limit switch shall disable the operator when the locks are engaged.

2.4 OPERATOR

A. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to free wheeling mode for manual operation.

C. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208/260/480 VAC, 60 Hertz operation (confirm power requirements with electrical sub to comply with project standard).

D. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards. Incoming electrical shall be: 208/230VAC 3-phase.

1. Controls shall include a programmable logic controller with digital message display. Controller shall include programmable close timers and programmable inputs/outputs

2. Motor starters shall be magnetic reversing, factory wired with overload and under voltage protection, and equipped with mechanical interlocks. All control components shall be enclosed in one enclosure with a wiring diagram placed on the inside of the cover.

3. If incoming voltage is single phase, control panel shall include a variable frequency drive to convert voltage to 3-phase for the motor

4. Enclosures shall be NEMA 4 with disconnect switch.

5. Pushbuttons (interior) for each door shall have one momentary pressure three-button push-button station marked “OPEN”, “CLOSE” and “STOP”. Push button enclosure shall be NEMA 4.

6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position. Provide cremone bolt limit switch to be used for HVAC or exhaust removal system.

7. Safety edges: Provide electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.

8. Photo eyes: Provide (1) exterior, jamb mounted, thru-beam type photo eyes, NEMA 4 rated.

9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor.

10. Radio controls: Provide one (1) DIGITAL radio receiver and (2) single button remotes per door. Remotes to open and close doors with single button.

11. Timer Activation Loop Detectors: Provide “pulse on exit type” loop detector to activate auto close timer once loop has been activated and cleared, include hand/auto switch to deactivate timer. G.C. to coordinate installation of preformed loop with installer prior to exterior apron being poured.

12. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring. GC shall coordinate with all affected subs to insure full operation of door system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Four-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION 083513

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior storefront framing.
2. Storefront framing for ribbon walls.
3. Storefront framing for punched openings.
4. Exterior manual-swing entrance doors

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.
2. Product Data for Credit MR 4: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

a. Include statement indicating costs for each product having recycled content.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
1. Joinery Details
2. Flashing and drainage details
3. Glazing details
4. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used.

C. Samples: For each exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

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

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this

Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:

   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings and as required by current codes.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller

   a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

   a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

D. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. 6.24 lbf/sq. ft.

2. Entrance Doors:

a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft..
b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft..

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 13.5 lbf/sq. ft.

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.85 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.47 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

H. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 4.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Custom Glass Company.
2. PGT Industries, Inc.
3. United States Aluminum.- Division of C.R. Laurence

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally improved
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front
4. Finish: Clear anodic finish
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inchthick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior

2. Door Design: Medium stile; 3-1/2-inch nominal width
3. Glazing Stops and Gaskets: Beveled snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbfto set the door in motion and not more than 15 lbf to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
1. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

C. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin
3. Quantities:

a. For doors up to 87 inches high, provide three hinges per leaf.
b. For doors more than 87 and up to 120 inches high, provide four hinges per leaf.

E. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

F. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

G. Manual Flush Bolts: BHMA A156.16, Grade 1.

H. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

I. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

J. Cylinders: BHMA A156.5, Grade 1.

1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation.

K. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

L. Operating Trim: BHMA A156.6.

M. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

N. Concealed Overhead Holders: BHMA A156.8, Grade 1.

O. Surface-Mounted Holders: BHMA A156.16, Grade 1.

P. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

Q. Weather Stripping: Manufacturer's standard replaceable components.

R. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

S. Silencers: BHMA A156.16, Grade 1.

T. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Glazing Sealants: As recommended by manufacturer.

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.

a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Color: As selected by Architect from manufacturer's full range of colors.

2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Color: Matching structural sealant.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.

B. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware, power supplies, back-ups and surge protection.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware Schedule”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Interior Aluminum Doors and Frames”.
4. Division 08 Section “Flush Wood Doors”.
5. Division 08 Section “Access Control Hardware”.
6. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

    a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    b. Door Closers: Comply with the following maximum opening-force requirements indicated:

        1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
        2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

    c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

3. NFPA 101: Comply with the following for means of egress doors:

    a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

    b. Thresholds: Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

    a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closers.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.

2. Acceptable Manufacturers:

a. Hager Companies (HA).
b. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:

a. Bommer Industries (BO).
b. McKinney Products (MK).
c. Pemko Manufacturing (PE).

C. Sliding Door Hardware: Sliding door hardware is to be of type and design as specified and should comply with ANSI/BHMA A156.14.

1. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.
2. Bi-folding Door Hardware: Rated for door panels weighing up to 125 lb.
3. Pocket Sliding Door Hardware: Rated for doors weighing up to 200 lb.

a. Acceptable Manufacturers:

1) Pemko Manufacturing (PE).
2) Richards-Wilcox, Inc. (RW).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:

a. Door Controls International (DC).
b. Rockwood Manufacturing (RO).

c. Trimco (TC).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

a. Acceptable Manufacturers:

1) Burns Manufacturing (BU).
2) Rockwood Manufacturing (RO).
3) Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
c. Refer to hardware sets for specified levels.

2. Acceptable Manufacturer:

a. Sargent Manufacturing (SA) - Degree Series.
b. Corbin Russwin (RU) – Access 3 Series.

D. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Master Key System: Cylinders are operated by a change key and a master key.

E. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Keys (where required): Ten (10)

F. Construction Keying: Provide construction master keyed cylinders. Provide construction master keys in quantity as required by project Contractor

G. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) – ML2000 Series.
b. Sargent Manufacturing (SA) – 8200 Series.
c. Yale Locks and Hardware (YA) – 8800FL Series.

A. Multi-Point Locksets, Security: Three-point locking system device engineered for in-swinging door applications on windstorm safe shelter rooms. Extra heavy duty steel component

construction securing the door to the frame at top, bottom and center latch positions. All three latching points are automatically activated when the device is locked.

1. Acceptable Manufacturers:

   a. Corbin Russwin Hardware (RU) - FE6800 Series.
   b. Sargent Manufacturing (SA) - FM7100 Series.
   c. Yale Locks and Hardware (YA) - 7380F Series.

B. Lock Trim Design: As specified in Hardware Sets.

2.6 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

B. Hurricane and Tornado Resistance Compliance: Conventional exit devices and tube steel removable mullions to be U.L. listed for windstorm components where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

C. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

   1. Acceptable Manufacturers:

      a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
      b. Sargent Manufacturing (SA) - 80 Series.
      c. Yale Locks and Hardware (YA) - 7000 Series.

D. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.

   1. Static Load Force Resistance: Minimum 3000 lbs certified independent tested.

   2. Acceptable Manufacturers:

      a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.
      b. Yale Locks and Hardware (YA) - 7150 / 7250 Series.

E. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - 700/900 Series.
b. Sargent Manufacturing (SA) - 980S Series.
c. Yale Locks and Hardware (YA) - M200 Series.

2.7 ELECTROMECHANICAL CONVENTIONAL EXIT DEVICES

A. Electrified Conventional Push Rail Devices (Heavy Duty): Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified below. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Yale Locks and Hardware (YA) - 7000 Series.

B. Electrified Options: As indicated in hardware sets, provide electrified exit device options including: electric latch retraction, electric dogging, outside door trim control, exit alarm, delayed egress, latchbolt monitoring, lock/unlock status monitoring, touchbar monitoring and request-to-exit signaling. Unless otherwise indicated, provide electrified exit devices standard as fail secure.

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

B. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.
b. Norton Door Controls (NO) - 8500 Series.

c. Sargent Manufacturing (SA) - 1431 Series.
d. Yale Locks and Hardware (YA) - 3500 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), fabricated from the following:

   a. Stainless Steel: 300 series, 050-inch thick.

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Acceptable Manufacturers:

   a. Burns Manufacturing (BU).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

   a. Burns Manufacturing (BU).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered

steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:

    a. Rixson Door Controls (RF).
    b. Rockwood Manufacturing (RO).
    c. Sargent Manufacturing (SA).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

    1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

    1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

    1. Pemko Manufacturing (PE).
    2. Reese Enterprises, Inc. (RS).
    3. Zero International (ZE).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SA - Sargent
4. RO - Rockwood
5. RU - Corbin Russwin
6. AD - Adams Rite
7. RF - Rixson
8. SU - Securitron
9. 00 - Other

ITEMS SHADED GRAY ARE FURNISHED BY SECTION 087400

Hardware Schedule

Set: 1.0

Doors: 101, 202B, 209A, 227

1	Cylinder as required	Key to System	626	RU	087100
	Aluminum Doors	Balance of hardware by Dr Mfg			

Notes:

Set: 2.0

Doors: 106

3	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
3	Electric Hinge (heavy weight)	T4A3386-QC12 4-1/2" x 4-1/2"	US32D	MK	087400
1	Exit Device with Card Reader	ED5200SN 1109605 M107 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A11	689	RU	087100

1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.
-Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside pushbar always permits egress.

Set: 3.0

Doors: 155

2	Continuous Hinge	CFM83SLF-HD1		PE	087100
2	Surface Bolt	988	Bright Zinc	SA	087100
1	Multi-Point Lock	FM7113 ECMD LC	US26D	SA	087100
1	Cylinder as required	Key to System	626	RU	087100
2	Closer (surface)	DC6210 A11	689	RU	087100
2	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
2	Sweep	315CN door width		PE	087100
2	Astragal	303CS		PE	087100

Set: 4.0

Doors: 140, 140I, NS, SS

1	Continuous Hinge	CFM83SLF-HD1 SER12		PE	087100
1	Exit Device with Card Reader	ED5200SN 1109605 M107 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A11	689	RU	087100
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100

1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.
-ps arm at door SS
-Hardware specified is to show design intent. Provide hardware tested to meet design pressures.
-Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside pushbar always permits egress.

Set: 5.0

Doors: TT, TT2

1	Continuous Hinge	CFM83SLF-HD1		PE	087100
1	Exit Device (rim, classroom)	ED5200S 110955 M107 M110 AP	630	RU	087100
1	Cylinder as required	Key to System	626	RU	087100
1	Rim Cylinder	3500-138-	626	RU	087100
1	Closer (surface)	DC6210 A11	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.

Set: 6.0

Doors: 142A, 234A, SS2, TT3, TT4

3	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
1	Mortise Lock (security storeroom)	ML2059 110T AP	626	RU	087100
1	Closer (surface)	DC6210 A11	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.

Set: 7.0

Doors: 145

3	Hinge	TA2314 x NRP 4-1/2" x 4-1/2"	US32D	MK	087100
1	Mortise Lock (security storeroom)	ML2059 110T AP	626	RU	087100
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Gasketing	303CS head & jambs		PE	087100

Set: 8.0

Doors: 107

2	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
1	Electric Hinge (heavy weight)	T4A3386-QC12 4-1/2" x 4-1/2"	US32D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily releases magnetic lock, permitting entry. Free egress at all times.

Set: 9.0

Doors: 225

2	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK	087100
4	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Removable Mullion	907BKM 7'		RU	087100
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400

1	Exit Device (rim, exit only)	ED5200A M110 M92	630	RU	087100
1	Cylinder as required	Key to System	626	RU	087100
2	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
2	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
2	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
2	Gasketing	S88D		PE	087100
2	Door Bottom	411ARL		PE	087100
2	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
2	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Position Switch	DPS-M-BK		SU	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 10.0

Doors: 102A, 125A, 125B, 131, 211A, 212, 225A

1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK	087100
2	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 11.0

Doors: 141, 143, 144, 146, 149, 151

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Electric Hinge	TA2714-QC12 4-1/2" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400

1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 11.1

Doors: 147

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 12.0

Doors: 216

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100

1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 13.0

Doors: 134, 202, 203A, 204, 205, 206, 207, 208, 209, 211

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Electric Hinge	TA2714-QC12 4-1/2" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 14.0

Doors: 107A, 152

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Exit Device (rim, classroom)	ED5200A 110955 M110 AP	630	RU	087100
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100

Set: 15.0

Doors: 101A

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Set: 16.0

Doors: 150

3	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
3	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Set: 17.0

Doors: 218

6	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt	555	US26D	RO	087100
1	Mortise Lock (storeroom)	ML2057 110T AP	626	RU	087100
2	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
2	Silencer	608		RO	087100

Set: 18.0

Doors: 217

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100

1 Mortise Lock (storeroom)	ML2057 110T AP	626	RU	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 19.0

Doors: 133

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Office Lock	ML2051 110T AP	626	RU	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 20.0

Doors: 102

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (classroom)	ML2055 110T AP	626	RU	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3 Silencer	608		RO	087100

Set: 21.0

Doors: 202A, 227A, 234

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (classroom)	ML2055 110T AP	626	RU	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 22.0

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Mortise Lock (classroom)	ML2055 110T AP	626	RU	087100
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100

Set: 23.0

Doors: 103, 108, 115, 121, 129, 130, 153, 210, 213, 226

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Mortise Lock (privacy)	ML2060 110T M19V	626	RU	087100
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100

Set: 24.0

Doors: 219A, 219B

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Mortise Lock (privacy)	ML2060 110T M19V	626	RU	087100
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100

Set: 25.0

Doors: 214, 215

3	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Mortise Lock (passage)	ML2010 110T	626	RU	087100

1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 26.0

Doors: 116, 125, 125C, 220A, 220B, 223, 223A

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1 Push Plate	70C	US32D	RO	087100
1 Pull	RM301	US32D	RO	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 27.0

Doors: 154

3 Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1 Push Plate	70C	US32D	RO	087100
1 Pull	RM301	US32D	RO	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1 Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 28.0

Doors: 104

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Office Lock	ML2051 110T AP	626	RU	087100
1 Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1 Door Stop	442 or 409 as required	US26D /	RO	087100

		US32D		
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Notes:

Set: 29.0

Doors: 224

6 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Dust Proof Strike	570	US26D	RO	087100
2 Flush Bolt	555	US26D	RO	087100
1 Mortise Lock (storeroom)	ML2057 110T AP	626	RU	087100
2 Surface Overhead Stop	9-X36	652	RF	087100
2 Silencer	608		RO	087100

Set: 30.0

Doors: 120, 156, 221, 222, 234B, 235

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (storeroom)	ML2057 110T AP	626	RU	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3 Silencer	608		RO	087100

Set: 31.0

Doors: 203B

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (classroom)	ML2055 110T AP	626	RU	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3 Silencer	608		RO	087100

Set: 32.0

Doors: 137, 139

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (privacy)	ML2060 110T M19V	626	RU	087100
1 Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100

1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3 Silencer	608		RO	087100

Set: 33.0

Doors: 132, 135, 136, 138

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Mortise Lock (privacy)	ML2060 110T M19V	626	RU	087100
1 Mop Plate	K1050 4" x 1"LDW	US32D	RO	087100
1 Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1 Gasketing	S88D		PE	087100
1 Door Bottom	411ARL		PE	087100

Set: 34.0

Doors: 109, 110, 111, 112, 113, 114, 122, 123, 124, 126, 127, 128

1 Sliding Door Hdwe	H180A/6		PE	087100
1 Mortise Deadlock	5017	630	AD	087100
1 Thumbturn	1015	RC130	AD	087100
1 Escutcheon	1016	RC130	AD	087100
2 Door Pull	110	US32D	RO	087100

Set: 35.0

Doors: 234C

1 Sliding Door Hdwe	H180A/6		PE	087100
1 Mortise Deadlock	5017	630	AD	087100
1 Thumbturn	1015	RC130	AD	087100
1 Escutcheon	1016	RC130	AD	087100
2 Door Pull	110	US32D	RO	087100
2 Safety chain with eye bolts			00	087100

Set: 36.0

Doors: 133A, 133B, 134A

1 Folding Door Hdwe	HF4/100A/6		PE	087100
2 Flush Pull	94	US32D	RO	087100

Set: 37.0

Doors: 117, 118, 119, 142B

1 Padlock	PL5000 AP	RU 087100

Set: 38.0

Doors: 140A, 140B, 140C, 140D, 140E, 140F, 140G, 140H, 148, 148A, 148B

Hardware furnished by door manufacturer

END OF SECTION 087100

SECTION 087400 – ACCESS CONTROL HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:
1. Electromechanical door hardware.
2. Integrated Wiegand access control door hardware.
3. Power transfer devices and wiring harnesses.
4. Monitoring and signaling equipment.
5. Access control cards and credentials.
6. Electrified and access control door hardware power supplies, back-ups and surge protection.

C. Related Sections:

1. Division 08 Section “Door Hardware Schedule”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Interior Aluminum Doors and Frames”.
4. Division 08 Section “Flush Wood Doors”.
5. Division 08 Section “Door Hardware”.
6. Division 28 Section “Access Control”.
7. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
8. Division 28 Sections "Access Control" for access control devices installed at door openings and provided as part of a security access system.
9. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
10. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.

4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards – A156 Series.
2. UL10C – Positive Pressure Fire Tests of Door Assemblies.

F. Products installed, but not provided under this Section include the following. Coordination to remain a requirement of this Section.

1. Security or High Security keyed cylinders, including provisions for temporary construction keying, provided for mechanical override at access control locking hardware to be furnished under Division 08 Section "Door Hardware". Permanent cores and keys to be installed by Owner.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. System Operational Descriptions: Complete system operational narratives for access controlled openings defining the owner's prescribed requirements for the

opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

3. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary integrated access control components.

D. Keying Schedule: Reference Division 08 Section "Door Hardware".

E. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete standard door and access control hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and telephone number of the supplier/integrator providing the installation and the nearest service representatives for each item of equipment included in the system. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

1. As-Built Drawings: During system installation, the Contractor to maintain a separate hard copy set of drawings, elevation diagrams, and wiring diagrams of the access control system to be used for record drawings. This set to be kept up to date by the Contractor with all changes and additions to the access control system accurately recorded.

G. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum[5] years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Integrator Qualifications (Access Control Door Hardware): Systems Integrators, verifiably factory trained and certified by the primary product manufacturers, with a minimum[3] years documented experience installing complete access control systems hardware similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance. Qualifications include, but are not necessarily limited, to the following:

1. References: Provide a list of references for similar projects including contact name, phone number, name and type of project.
2. Professional Staffing: Firms to have a dedicated access control systems integration department with full time, experienced professionals on staff experienced in providing on site consulting services for both electrified door hardware and integrated access control systems installations.
3. Factory Training: Installation and service technicians are to be competent factory trained and certified personnel capable of maintaining the system.
4. Service Center: Firms to have a service center capable of providing training, in-stock parts, and emergency maintenance and repairs at the Project site with 24-hour/7-days a week maximum response time.

C. Supplier Qualifications: Supplier, verifiably authorized and in good standing with the primary product manufacturers, with a minimum[3] years experience supplying integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance.

D. Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be supplied and installed only through designated ASSA ABLOY "Authorized Channel Partner" (ACP) and “Certified Integrator” (CI) accounts.

E. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide integrated access control door hardware from the same manufacturer as standard mechanical door hardware, unless otherwise indicated.

F. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

    a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    b. Door Closers: Comply with the following maximum opening-force requirements indicated:

        1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
        2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. NFPA 101: Comply with the following for means of egress doors:

    a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

    a. Test Pressure: Positive pressure labeling.

5. The installed access control system shall conform to all local jurisdiction requirements.

G. Keying Conference: Reference Section 087100 “Door Hardware.”

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), Systems Integrator(s), and Contractor(s) to review proper methods and procedures for receiving, handling, and installing door and access control hardware to manufacturer's recommendations and according to specifications.

1. Prior to installation of door hardware, arrange for manufacturers' representatives to hold a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures.

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedules.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

1. Access control firmware and software: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original manufacturer's sealed containers.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Integrated Access Control Door Hardware and Electrical Coordination: Coordinate the layout and installation of scheduled integrated access control door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.

1. Access Control System Interface: The integrated access control hardware to interface and be connected to the access control system described under Division 28 "Access Control Systems". Coordinate the installation and configuration of the electrified door hardware and access control systems firmware and software with the hardware specified in this Section.

B. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions

of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Two years for electromechanical and integrated access control door hardware.
2. Five years for motorized electric latch retraction exit devices. Ten years for mortise locks and latches.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of standard and access control door hardware.

B. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

1.9 SCOPE OF WORK

A. Access Control Site Management System: Furnish and install at the indicated locations the specified integrated access control door hardware for a completely operational access control and security site management system. System includes, but is not necessarily limited, to the following:

1. Electrified integrated access control locks and exit hardware, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.

a. Provide manufacturer approved integrated access control locks and exit hardware that are functionally compatible with the specified access control equipment interfaces.

2. Owner to provide the following:

   a. Owner will be responsible for ensuring that each computer hardware component includes the required interfaces, expansion boards, and peripherals that will be necessary to allow the system to operate as described within this specification and as indicated on the drawings.
   b. Power Sourcing, Network Switches and Wireless Access Points: Quantity as required to accommodate installed access control (and video surveillance) devices.
   c. Network Control Processor Connections:

      1) LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e (CAT6) cabling from network router/switch to network control processor, outlet and cover plates and/or patch cables required for network connection within each designated IT/Telecom room.
      2) Required static IP addresses.

3. Power Supplies, including battery, uninterrupted backup power supply (UPS) and separately fused surge protection, required for the integrated access control door hardware.

4. Installation, final configuration and commissioning of integrated access control door hardware, power supplies and related accessories.

5. Provide manufacturer required power controllers, interface boards, and programming that may be required for approved electric latch retraction exit devices supplied under Division 08 Section "Door Hardware."

6. Electrical contractor, Division 26, to provide the following:

   a. Source power wiring (120VAC) as required for the integrated access control door hardware and power supplies. This includes quad outlets as required on a dedicated circuit in the designated IT/Telecom room(s) and the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.
   b. Provide required conduit, stub-in, junction and back boxes for the integrated access control door hardware at each access controlled opening per plan drawings and specs. Supply and install conduit between the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.

      1) At electrified hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.

   c. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.

7. Access Control System Integrator to provide the following:

a. Low voltage wiring (12/24VDC) and communication required for electrified and integrated access control door hardware, remote card readers, keypads, or display terminals, monitoring and signaling switches, and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable codes and specified system operational narratives.

8. Final connections to fire alarm system, if required, by electrical and fire alarm system contractors.
9. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide integrated access control door hardware and accessories for each designated opening to comply with requirements in this Section and with the Access Control Hardware Sets listed at the end of Part 3.

1. Access Control Hardware Sets: Requirements for quantity, item, model, design, grade, finish, size, and other distinctive qualities of each type of integrated door and access control hardware are indicated in the Access Control Hardware Sets at the end of Part 3.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of mechanical and electrified door hardware are indicated in the Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. System Design: The electrified door hardware specified to include standardized components regularly manufactured and utilized within the source manufacturer’s product lines.

1. Electronic integrated locking hardware to be non-proprietary in design and implementations, providing for an open protocol platform across multiple access control systems manufacturers and software applications. The installed integrated product is to be part of a single, cohesive access control system.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electrified access control door hardware, in compliance with specifications, must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01 "Substitution Procedures". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

E. The electrified access control door hardware contained in this Section represents a complete engineered system. If alternate products are submitted, it is the responsibility of the Supplier to provide an acceptable complete and working system layout, including re-engineering of elevation and wiring diagrams, as applicable. Complete systems to include at a minimum the required power supplies, power transfers, and electrified and integrated locking hardware and accessories.

2.2 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

a. Hager Companies (HA) - ETW-QC (# wires) Option.
b. McKinney Products (MK) - QC (# wires) Option.

B. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a 12" removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

a. Bommer Industries (BO) - SER-QC (# of wires) Option.
b. McKinney Products (MK) - SER-QC (# wires) Option.
c. Pemko Manufacturing (PE) - SER-QC (# wires) Option.

A. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

B. Electric Door Hardware Cords: Provide electric transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Acceptable Manufacturers:

a. McKinney Products (MK) - Inner Door Cord 3 inches: QC-C003P.
b. McKinney Products (MK) - Inner Door Cord 3 foot door: QC-C206P.

c. McKinney Products (MK) - Inner Door Cord 4 foot door: QC-C306P.
d. McKinney Products (MK) - Inner Door Cord 15 feet: QC-C1500P.
e. McKinney Products (MK) - Hinge to Junction Panel 15 feet: QC-C1500P.

Provide one each of the following tools as part of the base bid contract:

f. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
g. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2.3 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 1 with minimum holding force strength of 1,100 pounds. Locks to be capable of either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Locks are to have an integrated door position switch and lock bond sensor. Locks are to have optional integrated motion sensor and/or security camera as indicated in the hardware sets. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Acceptable Manufacturers:

a. Securitron (SU) – M680 Series.

2.4 ELECTROMECHANICAL CONVENTIONAL EXIT DEVICES

A. Electrified Conventional Push Rail Devices (Heavy Duty): Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified below.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Yale Commercial Hardware (YA) - 7000 Series.

B. Electrified Options: As indicated in hardware sets, provide electrified exit device options including: electric latch retraction , electric dogging, outside door trim control, exit alarm, delayed egress, latchbolt monitoring, lock/unlock status monitoring, touchbar monitoring and request-to-exit signaling. Unless otherwise indicated, provide electrified exit devices standard as fail secure.

2.5 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw

latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). Fail safe or fail secure options.
4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
5. Competitor Alternates Allowed Option>Installation to include manufacturer's access control panel interface board or module where required for Wiegand output protocol.

6. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) - Access 600 - ED5000 RNE1 Series.
    b. Sargent Manufacturing (SA) - Harmony - H1/H2 80 Series.
    c. Yale Security (YA) - Symphony -7100 SYM Series.

2.6 WIRELESS ACCESS CONTROL EXIT DEVICES

2.7 ELECTRONIC ACCESSORIES

A. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.

1. Acceptable Manufacturers:

    a. Securitron (SU) - PB Series.

B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Acceptable Manufacturers:

    a. Securitron (SU) - DPS Series.

C. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage

failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:

   a. Sargent Manufacturing (SA) – 3500 Series.

2.8 SYSTEM APPLICATION SOFTWARE

2.9 CABLES AND WIRING

A. Comply with Division 27 Section "Conductors and Cables for Electronic Safety and Security."

B. Data Line Supervision: System to include alarm initiation capability in response to opening, closing, shorting, or grounding of data transmission lines.

C. Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by manufacturer, corresponding to the electronic locking functions specified, amperage drawn and distances covered between the power supplies, power transfer devices, electrified hardware and access control equipment.

2.10 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.11 ACCESS CONTROL HARDWARE FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Where specified, finishes on locksets, latchsets, exit devices and push/pull trim to incorporate an FDA recognized antimicrobial coating (MicroShield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified and integrated access control door hardware installation.

C. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Doors and frames at scheduled access controlled openings to be properly prepared to receive specified electrified and access control hardware and connections without additional in-field modifications.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

E. Boxed Power Supplies: Verify locations with Architect.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with access control equipment.

F. Final connect the system control switches (integrated reader locking hardware, remote readers, keypads, etc.), and monitoring and signaling equipment to the related Controller devices at each opening to properly operate the electrified door and access control hardware according to system operational narratives.

G. Stand Alone System Application Software: Install, and test stand alone system application software for the complete and proper operation of systems involved.

H. Networked System Application Software: Reference Division 28 Section "Access Control Systems".

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Perform a final inspection of the installed door hardware and access control system and state in report whether installed work complies with or deviates from requirements, including whether each component representing the opening assembly is properly installed, adjusted, operating and performing to system operational narratives.

B. Commissioning and Testing Schedule: Reference Division 28 Section "Access Control System."

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

ITEMS SHADED IN GRAY ARE FURNISHED BY SECTION 087400

Set: 2.0

Doors: 106

3	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
3	Electric Hinge (heavy weight)	T4A3386-QC12 4-1/2" x 4-1/2"	US32D	MK	087400
1	Exit Device with Card Reader	ED5200SN 1109605 M107 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A11	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.
-Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside pushbar always permits egress.

Set: 4.0

Doors: 140, 140I, NS, SS

1	Continuous Hinge	CFM83SLF-HD1 SER12		PE	087100
1	Exit Device with Card Reader	ED5200SN 1109605 M107 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A11	689	RU	087100
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Exterior doors and hardware to comply with FBC windstorm requirements.
-ps arm at door SS
-Hardware specified is to show design intent. Provide hardware tested to meet design pressures.
-Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside pushbar always permits egress.

Set: 8.0

Doors: 107

2	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
1	Electric Hinge (heavy weight)	T4A3386-QC12 4-1/2" x 4-1/2"	US32D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Threshold	2005AV		PE	087100
1	Gasketing	303CS head & jambs		PE	087100
1	Sweep	315CN door width		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily releases magnetic lock, permitting

entry. Free egress at all times.

Set: 9.0

Doors: 225

2	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK	087100
4	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Removable Mullion	907BKM 7'		RU	087100
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Exit Device (rim, exit only)	ED5200A M110 M92	630	RU	087100
1	Cylinder as required	Key to System	626	RU	087100
2	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
2	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
2	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
2	Gasketing	S88D		PE	087100
2	Door Bottom	411ARL		PE	087100
2	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
2	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Position Switch	DPS-M-BK		SU	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 10.0

Doors: 102A, 125A, 125B, 131, 211A, 212, 225A

1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK	087100
2	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 11.0

Doors: 141, 143, 144, 146, 149, 151

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Electric Hinge	TA2714-QC12 4-1/2" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 11.1

Doors: 147

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100

1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
3	Silencer	608		RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 12.0

Doors: 216

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 13.0

Doors: 134, 202, 203A, 204, 205, 206, 207, 208, 209, 211

2	Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1	Electric Hinge	TA2714-QC12 4-1/2" x 4-1/2"	US26D	MK	087400

1	Access Control Mort Lock	ML20608-TCRNE1-SEC 110T M812 AS	630	RU	087400
1	Closer (surface)	DC6210/DC6200 as required	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Door Stop	442 or 409 as required	US26D / US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Notes: -Operation: presenting valid credential to reader temporarily unlocks outside trim, permitting entry. Outside trim is fail secure with key override. Inside leverr always permits egress.

Set: 15.0

Doors: 101A

2	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
1	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400
1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	Gasketing	S88D		PE	087100
1	Door Bottom	411ARL		PE	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

Set: 16.0

Doors: 150

3	Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK	087100
3	Electric Hinge (heavy weight)	T4A3786-QC12 5" x 4-1/2"	US26D	MK	087400
1	Exit Device with Card Reader	ED5200AN 1109605 M110 M812 TCRNE1 AS	630	RU	087400

1	Closer (surface)	DC6210 A3	689	RU	087100
1	Kick Plate	K1050 8" x 2"LDW CSK	US32D	RO	087100
1	Wall Stop	406	US32D	RO	087100
1	ElectroLynx Harness dr to hinge	QC-Cxxx length as req		MK	087400
1	ElectroLynx Harness hinge to ceiling	QC-Cxxxx length as req		MK	087400
1	Power Supply	BPS-24-1		SU	087400

MISC

1	Wiegand Test Kit	WT1	RU

END OF SECTION 087400

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites and storefront framing.
2. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

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. AGC Glass Company North America, Inc.
2. Dlubak Corporation.
3. Gardner Glass, Inc.
4. GGI; General Glass International.
5. Guardian Industries Corp.; SunGuard.
6. Pilkington North America.
7. PPG Industries, Inc.
8. Tecnoglass.
9. Architects approved substitution meeting project requirements.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.

3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

B. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located more than 30 feet above grade.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.
2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
3. Ionomeric polymer interlayer.
4. Cast-in-place and cured-transparent-resin interlayer.
5. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Sika Corporation.
b. Tremco Incorporated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

F. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

   1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

A. Interior Glass: Fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

B. Exterior glass: Tinted fully tempered float glass.

1. Basis-of-Design Product: PPG Solexia Glass.
2. Tint Color: Green.
3. Minimum Thickness: ¼”.
4. Visible Light Transmittance: .85 percent minimum.
5. Solar Heat Gain Coefficient: .47 maximum.

3.7 LAMINATED GLASS SCHEDULE

A. Exterior Glass: Clear laminated glass with two plies of heat-strengthened float glass.
1. Minimum Thickness of Each Glass Ply: ¼”
2. Interlayer Thickness: 0.090 inch.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.
2. Tempered glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

D. Samples: For each type of the following:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.3 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion manufacture.

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. Avalon Glass and Mirror Company.
2. Binswanger Mirror; a division of Vitro America, Inc.
3. D & W Incorporated.
4. Architects approved substitution meeting project requirements.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503

B. Annealed Monolithic Glass Mirrors: Mirror Glazing Quality, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.

1. Nominal Thickness: 6.0 mm

C. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: 6.0 mm

D. Laminated Mirrors: ASTM C 1172, Type II.

1. Glass for Outer Lite: Annealed float glass, Mirror Glazing Quality, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
2. Nominal Thickness for Outer Lite: 6.0 mm Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
3. Nominal Thickness: 6.0 mm
4. Interlayer: 0.030-inch-thick, clear polyvinyl-butyral.

E. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating approved by mirror manufacturer.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Laurence, C. R. Co., Inc.
   b. Liquid Nails Adhesive.
   c. Pecora Corporation.

2. Adhesives shall have a VOC content of 70 g/L or less.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.

   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) Andscot Company, Inc.
      2) Laurence, C. R. Co., Inc.
      3) Stylmark, Inc.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.

   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) Andscot Company, Inc.
      2) Laurence, C. R. Co., Inc.
      3) Stylmark, Inc.

3. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: Beveled polished edge of width shown. Seal edges of mirrors with edge sealer.

C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 089000 - LOUVERS AND VENTS

1.1 General

A. Summary

1. Furnish and install louvers, screens, blank-off panels, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.

2. The louvers to be furnished include the following:

a. Dade County approved louvers in compliance with Florida Building Code and other project requirements. Louver attachment shall be engineered to comply with the required design pressures and wind velocity design as indicated in the drawings. Provide signed and sealed calculations indicating compliance.

3. Related sections include:

a. Division 7 Section 079200 - Joint Sealants for sealants installed in perimeter joints between louver frames and adjoining construction.

4. Coordination:

a. The GC at time of bid shall review all disciplines to insure that all louver and vent requirements have been acknowledged and coordinated to insure that all project requirements have been met by a single source whether completely indicated on the drawing elevations or not.

B. References

1. Building Services Research and Information Association.

a. Provide louvers that have been tested and are in compliance with BSRIA “Method of Test for Water Rejection Performance of Louvers Subjected to Simulated Rainfall (Wind Driven Test)”.
b. Louvers shall be “Storm Resistant” Louvers.

2. Air Movement and Control Association AMCA.

a. Comply with AMCA 500-L-99 testing certification.

3. The Aluminum Association Incorporated

a. Aluminum Standards and Data

b. Specifications and Guidelines for Aluminum Structures

4. American Society of Civil Engineers

a. Minimum Design Loads for buildings and Other Structures

5. American Society for Testing and Material
   a. ASTM B209
   b. ASTM B211
   c. ASTM B221
   d. ASTM E90-90

6. Architectural Aluminum Manufacturers Association

a. AAMA 800 Voluntary Specifications and Test Methods for Sealants.
b. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
c. AAMA TIR Metal Curtain Wall Fasteners
d. AAMA 2605-98 Superior Performing Organic Coating on Aluminum Extrusions and Panels.

7. Dade County Protocols

a. PA 100(A)-95 Test Procedures For Wind and Wind Driven Rain Resistance and/or Increased Wind Speed Resistance of Soffit Ventilation Strip and Continuous or Intermittent Ventilation System Installed at Ridge Area.
b. PA-201-95 Impact Test Procedure.
c. PA-202-95 Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure.
d. PA-203-95 Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.

C. Submittals
   1. Product Data

a. Air flow and water entrainment performance test results.
b. Material types and thickness.

2. Shop Drawings

a. Include elevations, sections and specific details for each louver.
b. Show anchorage details and connections for all component parts.
c. Provide current NOA for all products provided.
d. If required, provide signed and sealed structural calculations as prepared by a Florida Registered Structural Engineer indicating compliance with design and wind requirements of this project.

3. Samples: Submit if required by the Architect.

4. Finish: Standard powder-coat factory finish. Color to be as selected from manufacturer's full color range. Submit samples..

D. Quality Assurance

1. Single subcontract responsibility: Subcontract the work to a single firm that has no less than six years experience in the design and manufacturing of work similar to that shown and required.

2. Performance Requirements: Provide ***AMCA and BSRIA*** test data as required to confirm that the louvers have the specified air and water performance characteristics.

3. Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.

4. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code, or as otherwise specified in the project. Maximum allowable deflection for the louver structural member to be 1/180 or .75 inch, whichever is less. Maximum allowable deflection for the lover blades to be 1/120 or .50 inch across the weak axis, whichever is less.

5. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional structural engineer licensed to practice in the state of Florida.

6. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of two years from date of substantial completion.

E. Delivery, Storage and Handling

1. Delivery: At the time of delivery all material shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

2. Storage:

a. Material may be stored flat, on end or on its side.
b. Material may be stored either indoors or outdoors.
c. If stored out doors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.

3. Handling

a. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.
b. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.
c. Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

1.2 Products

A. Basis of Design:

a. The louvers and related materials herein specified and indicated on the drawings shall be as manufactured by United Enertech, Inc., Chattanooga, Tennessee. Model SED-5.1.

B. Other acceptable manufacturer's include:

a. Ruskin, Kansas City, MO. Model EME-520-MD
b. Airolite, Marietta, Ohio. Model K-605-MD
c. CS Group, Cranford, NJ. Model DC-5304.
d. Architects approved equal subject to conformance with project requirements.

C. Materials

1. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6, or 6061-T6.

2. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

D. Fabrication, General

1. Provide louver models, bug screens, blank-off panels, structural supports and accessories as required and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

2. Louvers to be mechanically assembled using stainless steel fasteners.

3. Include supports, anchorage, and accessories required for complete assembly.

E. Finishes

1. General: Comply with NAAMM AMetal Finishes Manual@ for designations and application recommendations, except as otherwise indicated. Apply finished in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.
2. Two Coat Fluorocarbon Coating

    a. Louvers to be finished with a minimum 1.0 mil (0.025mm) thick full strength 70 % resin, 2 coat Fluorocarbon system.

    b. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the MICA II coating. The coating shall consist of a primer and a pearlescent pigmented PFV2 topcoat. It shall receive a bake cycle of 17 minutes at 450ºF. All finishing procedures shall be one continuous operation in the plant of the manufacturer.

    c. Manufacturer to furnish an extended 20 year limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

F. Screens

1. Unless otherwise indicated, all louvers to be furnished with mill finish bird or insect screens depending on location and logic.

2. Screens to be 18 x 16 aluminum mesh 0.011" (0.279mm) diameter wire insect screens secured within 0.055" (1.40mm) thick extruded aluminum frames. Frames to have mitered corners and corner locks.

G. Blank Offs

1. Furnish where indicated on the drawing blank-off panels fabricated by the louver manufacturer.

2. Blank-off panels to be 1" (25.4mm) thick and to be faced on both sides with 0.032" (0.81 mm) thick aluminum sheet. Panels to be fabricated with an expanded polystyrene (EPS) core having an R- value of 4 (_F*ft2*h/Btu). Panel perimeter frame to be 0.050" (1.27mm) thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished to match louvers.

1.3 Execution

A. Examination: Examine openings to receive the work. Do not proceed until all unsatisfactory conditions have been corrected.

B. Installation

1. Comply with manufacturer=s instructions and recommendations for installation of the work.

2. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.

3. Anchor louvers to the building substructure as indicated on drawings.

4. Erection Tolerances:
   a. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 2" in any total building length or portion thereof (non-cumulative).

   b. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

5. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

6. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

7. Set units level, plumb and true line, with uniform joints.

C. Protection

1. Protect installed materials to prevent damage by other trades. Use material that may be easily removed without leaving residue or permanent stains.

D. Adjusting and Cleaning

1. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

2. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.

3. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results or restoration are unsuccessful, as determined by the Architect, remove damaged material and replace with new materials.

   a. Touch up minor abrasions in finished with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION 089000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation reports for firestop tracks.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Use of 25 gauge metal NOT ALLOWED.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:
   a. Minimum Base-Metal Thickness: 0.0269 inch
   b. Depth: As indicated on Drawings

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   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) Blazeframe Industries.
      2) CEMCO; California Expanded Metal Products Co.
      3) ClarkDietrich Building Systems.
      4) MBA Building Supplies.
      5) Metal-Lite.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Blazeframe Industries.
   b. CEMCO; California Expanded Metal Products Co.
   c. ClarkDietrich Building Systems.
   d. Fire Trak Corp.
   e. Metal-Lite.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0296 inch

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inches

2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0296 inch
2. Depth: 1-1/2 inches

I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: hat shaped

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 3/4 inch
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.

2. Steel Studs and Runners: ASTM C 645.

   a. Minimum Base-Metal Thickness: 0.0269 inch
   b. Depth: As indicated on Drawings

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

   a. Minimum Base-Metal Thickness: 0.0296 inch

4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

   a. Configuration: hat shaped

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide foam gasket
   1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

   1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
   2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
   3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
   4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092400 – PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior vertical plasterwork (stucco).
2. Exterior horizontal and nonvertical plasterwork (stucco).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.

2.2 METAL LATH

A. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet with ASTM A 653/A 653M, G60, hot-dip galvanized-zinc coating.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Paper Backing: FS UU-B-790a, Type I, Grade B, Style 1a vapor-retardant paper

1. Provide paper-backed lath in locations indicated on drawings

2.3 ACCESSORIES

A. General: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. PVC.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Phillips Manufacturing Co.
   b. Plastic Components, Inc.
   c. Vinyl Corp; a division of ClarkDietrich Building Systems.

2. Cornerbeads: With perforated flanges.

   a. Smallnose cornerbead; use unless otherwise indicated.
   b. Bullnose cornerbead, radius 3/4-inch minimum; use at locations indicated on Drawings.

3. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.

   a. Square-edge style; use unless otherwise indicated.
   b. Bullnose style, radius 3/4-inch minimum; use at locations indicated on Drawings.

4. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
5. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch-wide reveal; with perforated concealed flanges.

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in cement plaster.

C. Bonding Compound: ASTM C 932.

D. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.

E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

F. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2.5 PLASTER MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I

1. Color for Finish Coats: Gray.

B. Masonry Cement: ASTM C 91, Type N.

1. Color for Finish Coats: Gray.

C. Plastic Cement: ASTM C 1328.

D. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

E. Sand Aggregate: ASTM C 897.

2.6 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 1-1/2 to 2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 1-1/2 to 3 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: Use 1 part plastic cement and 1-1/2 to 3 parts aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Prepare smooth, solid substrates for plaster according to ASTM C 926.

B. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

C. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.2 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C 1063.

3.3 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Locate as indicated on Drawings. Full compliance with ASTM C 1063 required whether indicated on the drawings or not.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.

C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 5/8 to 3/4-inch total thickness, as follows:

1. Portland cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 3/4-inch total thickness for metal lath on concrete, as follows:

1. Portland cement mixes.

3.5 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives and sealants, indicating VOC content.
2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.

C. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.

2. Thickness: 5/8 inch.

3. Long Edges: Tapered

C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Georgia-Pacific Building Products.
   b. National Gypsum Company.
   c. PABCO Gypsum.

2. Thickness: 1/4 inch.

3. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Georgia-Pacific Building Products.
    b. National Gypsum Company.
    c. PABCO Gypsum.

2. Thickness: 5/8 inch.

3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. CertainTeed Corporation.
    b. Georgia-Pacific Building Products.
    c. National Gypsum Company.

2. Core: 5/8 inch

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Custom Building Products.
    b. FinPan, Inc.
    c. James Hardie Building Products, Inc.

2. Thickness: 5/8 inch

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Plastic
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Plastic.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type**,** all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Adhesives shall have a VOC content of **50** g/L or less.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hilti, Inc.
b. Pecora Corporation.
c. United States Gypsum Company.

2. Sealant shall have a VOC content of 250 g/L or less.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C 840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints**,** rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile
3. Level 3: Rooms labeled 116, 117,118, 119, 120,216,217, 218, 220, 222, and 224.
4. Level 4: All other building areas unless noted otherwise

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: Rooms labeled 101, 201, 228, North Stair, 227

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

6. Architect shall have final say on adequacy of finishes.

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Stone thresholds.
3. Tile backing panels.
4. Waterproof membrane for thinset applications.
5. Crack isolation membrane.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Samples:
1. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
2. Stone thresholds.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification or comparable certification.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Tile- As indicated in the Interior design drawing and specifications.

2.3 THRESHOLDS

A. General: As indicated in the Interior design drawing and specifications..

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Custom Building Products.
b. FinPan, Inc.
c. Georgia-Pacific Building Products.

2. Thickness: 5/8 inch

B. Fiber-Cement Backer Board: ASTM C 1288.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CertainTeed Corporation.
b. James Hardie Building Products, Inc.

2. Thickness: 5/8 inch

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Nominal Thickness: 0.040 inch.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.

1. Nominal Thickness: 0.040 inch.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.

F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

H. Latex-Portland Cement Waterproof Mortar: Flexible, waterproof mortar consisting of cement-based mix and latex additive.

I. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.

1. Urethane Waterproofing and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch nominal thickness.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.

F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.

G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

I. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

J. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

1. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),] in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Jamo Inc.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2. For wall applications, provide nonsagging mortar.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Organic Adhesive: ANSI A136.1, Type I, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 7 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

2.8 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Jamo Inc.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2.9 MISCELLANEOUS MATERIALS

A. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

   a. Exterior tile floors.
   b. Tile floors in wet areas.
   c. Tile floors in laundries.
   d. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: As specified in interior design drawings and specifications.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

I. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

J. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 EXTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Exterior Deck Floor Installations:

1. Ceramic Tile Installation: as indicated in drawings.

a. Ceramic Tile Type: as indicated in interior design drawings

3.5 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation- TCNA F111 and ANSI A108.1A cement mortar bed (thickset) with cleavage membrane.

a. Ceramic Tile Type: porcelain tile.
b. Grout: High-performance unsanded grout.

B. Shower Receptor and Wall Installations:

1. Ceramic Tile Installation : TCNA B414 and ANSI A108.1A cement mortar bed (thickset) over vapor-retarder membrane.

a. Ceramic Tile Type: porcelain
b. Bond Coat for Wet-Set Method: Standard dry-set mortar.
c. Grout: High-performance unsanded.

END OF SECTION 093013

SECTION 095110 – ACOUSTICAL PANEL CEILINGS

Part 1 – General

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes
1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Selections
1. Section 095310 – Cloud and Canopy Ceilings
2. Section 095425 - Wood Panel Ceilings
3. Divisions 23 - HVAC Air Distribution
4. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material
10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
12. ASTM E 1264 Classification for Acoustical Ceiling Products

B. Florida Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

G. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SYSTEM DESCRIPTION

A. Continuous/Wall-to-Wall

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure: HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.9 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion.
3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is Thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:
1. Armstrong World Industries, Inc.

B. Suspension Systems:
1. Armstrong World Industries, Inc.

C: Perimeter Systems
1. Armstrong World Industries, Inc.

2.2.1 ACOUSTICAL CEILING UNITS

A. Acoustical PanelsP
1. Surface Texture: Smooth
2. Composition: Mineral Fiber
3. Color: White
4. Size: 24IN x 24IN
5. Edge Profile: Beveled Tegular 9/16IN for interface with Suprafine XL 9/16" Exposed Tee Grid.
6. Noise Reduction Coefficient(NRC): ASTM C 423; Classified with UL label on product carton 0.85.
7. Ceiling Attenuation Class (CAC) : ASTM C 1414; Classified with UL label on product

carton 32.
8. Articulation Class (AC): 170
9. Flame Spread: ASTM E 1264; Class A (HPVA)
10. Light Reflectance White Panel: ASTM E 1477; 0.86
11. Dimensional Stability: HumiGuard Plus
12. Recycle Content: Post-Consumer - 1% Pre-Consumer Waste - 75%
13. Acceptable Product: Calla, 2824 as manufactured by Armstrong World Industries

2.3.1 METAL SUSPENSION SYSTEMS

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with 9/16 inch exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

1. Structural Classification: ASTM C 635 Intermediate Duty
2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise
3. Acceptable Product: Suprafine XL 9/16" Exposed Tee as manufactured by Armstrong World Industries

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:
7804 - 12ft Hemmed Angle Molding

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycle of the ceiling.

END OF SECTION 095110

SECTION 095310 – CLOUD AND CANOPY CEILINGS

Part 1 – General

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes
1. Acoustical Curved Ceiling panels
2. Suspension System
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Selections
1. Section 095110 - Acoustical Panel Ceilings
2. Section 095425 – Wood Panel Ceilings
6. Divisions 23 - HVAC Air Distribution
7. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material
    A. Armstrong Fire Guard Products
10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
12. ASTM E 1264 Classification for Acoustical Ceiling Products

B. Florida Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
G. International Code Council-Evaluation Services Report - Seismic Engineer Report
    1. ESR 1308 - Armstrong Suspension Systems
H. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SYSTEM DESCRIPTION
A. Canopies/Architectural Elements

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.
3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure:

1. Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

1.10 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: One (1) year from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.11 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:

1. Armstrong World Industries, Inc.

B. Suspension Systems:

1. Armstrong World Industries, Inc.

C: Perimeter Systems

1. Armstrong World Industries, Inc.

2.2.1 ACOUSTICAL CEILING UNITS

A. Acoustical Panels – Clouds, see drawings

1. Surface Texture: Fine
2. Composition: Fiberglass
3. Color: White
4. Size: 48IN x 48IN
5. Edge Profile: Square
6. Noise Reduction Coefficient(NRC):
7. Ceiling Attenuation Class (CAC) :
8. Articulation Class (AC):
9. Flame Spread: ASTM E 1264; Class A (UL)
10. Light Reflectance White Panel: ASTM E 1477; 0.90
11. Dimensional Stability: Standard

12. Recycle Content: Post-Consumer - 12% Pre-Consumer Waste - 59%
13. Acceptable Product: SoundScapes Shapes, 5443 as manufactured by Armstrong World Industries

2.2.2 ACOUSTICAL CEILING UNITS

A. Acoustical Panels – Canopies, see drawings
1. Surface Texture: Fine
2. Composition: Mineral Fiber
3. Color: White
4. Size: 36IN x 36IN
5. Edge Profile: Square
6. Noise Reduction Coefficient(NRC):
7. Ceiling Attenuation Class (CAC) :
8. Articulation Class (AC):
9. Flame Spread: ASTM E 1264; Class A (IBC)
10. Light Reflectance White Panel: ASTM E 1477; 0.86
11. Dimensional Stability: Standard
12. Recycle Content: Post-Consumer - 0% Pre-Consumer Waste - 47%
13. Acceptable Product: SoundScapes Acoustical Canopies, 6260 as manufactured by Armstrong World Industries

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycle of the ceiling.

END OF SECTION 095310

SECTION 095425 – WOOD PANEL CEILINGS

Part 1 - General

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section

1.2 SUMMARY

A. Section Includes
1. Solid Wood and Wood veneer ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, wall angle moldings and accessories.

B. Related Sections:
1. Section 095110 - Acoustical Pane l Ceilings
2. Section 095310 – Cloud and Canopy Ceilings
3. Division 23 - HVAC
4. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
1) ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2) ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3) ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4) ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

5) ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6) ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7) ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
8) ASTM E 1264 Classification for Acoustical Ceiling Products

B. Hardwood Plywood & Veneer Association (HPVA)

C. Florida Building Code

D. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality

E. NFPA 70 National Electrical Code

F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

G. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.

C. Samples: Minimum of two 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.

D. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

F. All products not conforming to manufacturers current published values must be removed and dispose. Replace with complying product at the expense of the Contractor performing the work.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested by HPVA (Hardwood Plywood and Veneer Association) under the test standard ASTM E-84 tunnel test and complying with ASTM E 1264 for Class A products.

a. Flame Spread: 25 or less

b. Smoke Developed: 50 or less

C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

D. Woodworkds Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

E. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.

B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.7 PROJECT CONDITIONS

A. Prior to installation, the wood veneer ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.

B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.8 WARRANTY

A. Wood Veneer Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:

1. Ceiling Panels: Defects in materials or factory workmanship
2. Grid System: Rusting and manufacturing defects

B. Warranty Period:
1. Wood veneer panels: Five (5) years from date of Substantial Completion
2. Grid: Ten years from date of Substantial Completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
1. Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:
1. Armstrong World Industries, Inc.

B. Suspension Systems:
1. Armstrong World Industries, Inc.

2.2.1 WOOD VENEER CEILING UNITS

A. Ceiling Panels – Wood Veneer:
1. Surface Texture: Smooth
2. Composition: Fire-retardant Particle Board
3. Species/Finish: Natural Variations Maple
4. Size: 24IN x 24IN
5. Reveal: Vector 15/16IN
6. Profile: 15/16 IN
7. Edge Banding and Trim: To match face veneer
8. Noise Reduction Coefficient (NRC): ASTM C 423, Classified with UL label on product carton undefined
9. Flame Spread: ASTM E84 HPVA Fire Classification Class A (HPVA)
10. Dimensional Stability: Standard
11. Acceptable Product: WoodWorks Vector, Item # 5401W1NMP as manufactured by Armstrong World Industries

B. WoodWorks Panel Accessories:
1. 440 - Vector Border Clip
2. 442 - Vector Hold Down Clip
3. 8200100 - 1" Fiberglass Infill Panel (Black - Gloss)

2.3.1 METAL SUSPENSION SYSTEMS

A. Components:

1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 Heavy Duty
   b. Color: Tech Black and match the actual color of the selected ceiling tile, unless noted otherwise.
   c. Acceptable Product: Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries

B. Attachment Devices:

1. Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties:

1 ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Wood Works Edge Moldings and Trim:
7800 - 12ft Wall Molding

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.

B. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095425

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

PART 2 - PRODUCTS

2.1 VINYL BASE

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. Armstrong World Industries, Inc.
2. Flexco.
3. Johnsonite; A Tarkett Company.

B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I, solid, homogeneous
2. Style and Location:

a. Style A, Straight: Provide in areas with carpet
b. Style B, Cove: Provide in areas with resilient flooring.

C. Minimum Thickness: See interior design drawings

D. Height: See interior design drawings

E. Lengths: Cut lengths 48 inches long

F. Outside Corners: Job formed

G. Inside Corners: Job formed

H. Colors and Patterns: See interior design drawings

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less

B. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Miter corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.
2. Rubber floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: Product Data for Credit EQ 4.1: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.

C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 SOLID VINYL FLOOR TILE

A. As indicated in interior design drawings.

B. Tile Standard: ASTM F 1700.

1. Class: As indicated by product designations
2. Type: A, smooth surface

C. Size: See interior design drawings.

D. Colors and Patterns: See interior design drawings.

2.3 RUBBER FLOOR TILE

A. As indicated in interior design drawings.

B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color

C. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240.

D. Wearing Surface: Textured

1. Molded-Pattern Figure: As indicated in interior design drawings.

E. Thickness: 0.125 inch

F. Size: As indicated in interior design drawings

G. Colors and Patterns: As indicated in interior design drawings

2.4 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall have a VOC content of 60 g/L or less.

2. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

B. Seamless-Installation Accessories:

1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

a. Use chemical-bonding compound that has a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft.in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles – as indicated in interior design drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles- As indicated in interior design drawings

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply three coat(s).

C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes poured-in-place portland cement terrazzo flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work.

D. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is a contractor member of NTMA.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Maintain temperature above 50 deg F for 48 hours before and during terrazzo installation.

B. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 PORTLAND CEMENT TERRAZZO

A. Portland Cement Terrazzo System Monolithic.
   1. Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.

      a. Terrazzo Topping Thickness: ½”
      b. Mix Color and Pattern: As selected by Architect from NTMA standard-terrazzo plates

B. Materials:

   1. Portland Cement: ASTM C 150, Type 1.

      a. Color for Exposed Matrix: As required by mix indicated

   2. Water: Potable.
   3. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
      a. 24-Hour Absorption Rate: Less than 0.75 percent.
      b. Dust Content: Less than 1.0 percent by weight.

   4. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
   5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
   6. Bonding Agent: Neat portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

2.3 STRIP MATERIALS

A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

   1. Material: White-zinc alloy
   2. Depth: 3/4 inch
   3. Width: 1/8 inch

B. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.

1. Material: White-zinc alloy
2. Top-Section Width: 1/8 inch

C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

E. Abrasive Strips: Three-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.

1. Width: 1/2 inch
2. Depth: As required by terrazzo thickness.
3. Length: 4 inches less than stair width
4. Color: As selected by Architect from full range of industry colors

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Recommended by manufacturer for this use.

1. Adhesives shall have a VOC content of **70** g/L or less.

B. Strip Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

C. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; or cork; minimum 1/2 inch wide

D. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

E. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.
3. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.

B. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Test for moisture content by method recommended in writing by terrazzo manufacturer.

3.2 INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet noncumulative.

C. Strip Materials:

1. Divider and Control-Joint Strips:

a. Locate divider strips directly over control joints, breaks, and saw cuts in concrete slabs.
b. Install control-joint strips back to back and directly above concrete-slab control joints
c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

D. Terrazzo Installation: Pour in place and seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Cure and finish portland cement terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

E. Repair: Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.3 CLEANING AND PROTECTION

A. Terrazzo Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096613

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For flooring products, indicating compliance with requirements for testing and product requirements of CRI's "Green Label Plus" testing program.

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each exposed product and for each color and texture required.

1.4 IINFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Refer to interior design drawings for specifications, color, size, and other requirements.

B. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

C. Sustainable Design Requirements:

1. Carpet and cushion shall comply with testing and product requirements of CRI's "Green Label Plus" testing program.

D. Performance Characteristics:

1. Appearance Retention Rating: Moderate traffic, 2.5 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.22 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 5 lbf according to ASTM D 1335.
5. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
6. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).

7. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
8. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
9. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

A. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft**.,** and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft**.** in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. At no additional cost to the Owner, perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

C. Metal Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.

1. Access Flooring Systems: Verify access floor substrate is compatible with carpet tile and adhesive, if any, and underlayment surface is gaps greater than 1/8 inch and protrusions more than 1/32 inch.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns As indicated on interior design drawings

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Steel and iron.
   2. Aluminum (not anodized or otherwise coated).
   3. Portland cement plaster (stucco).

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and each color and gloss of topcoat.

C. LEED Submittal:

   1. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

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. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Glidden Professional.
4. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated on the drawings, see elevation s chedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. 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.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE (based on Sherwin Williams Products)

A. Ferrous metals; primed (all surfaces):
   1. Touch-up shop primed surfaces.
      SW KemKromik Universal primer.
   2. Topcoat (2) coats.
      SW Industrial Enamel B 54 Series.

B. Ferrous metal; unprimed (all surfaces, piping, conduit):
   1. Primer.
      SW KemKromik Universal primer.
   2. Topcoat (2) coats.
      SW Industrial Enamel B 54 Series.

C. Galvanized metal and aluminum (all surfaces, piping, conduit):
   1. One (1) coat of SW Galvinite HS 3.0 - 4.5 m.d.f.t.
   2. Two (2) coats SW Industrial Enamel 2.0 - 4.0 m.d.f.t.

D. Masonry, concrete, and stucco:
   1. One (1) coat SW Loxon Hot Stucco primer
   2. Two (2) coats SW Loxon Topcoat 2.0 - 4.0 m.d.f.t.

E. Wood.
   1. One (1) coat SW A-100 exterior oil wood primer.
   2. Two (2) coats SW A-100 100% Acrylic Gloss 1.4 m.d.f.t.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:
   1. Concrete masonry units (CMUs).
   2. Aluminum (not anodized or otherwise coated).
   3. Wood.
   4. Gypsum board.
   5. Steel

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals:

   1. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.

C. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

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. Benjamin Moore & Co.
2. Glidden Professional.
3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. 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.

3.4 INTERIOR PAINTING SCHEDULE

A. <u>Interior Surfaces</u>

1. Interior plaster.
   a. One (1) coat; one point four (1.4) m.d.f.t. SW Masonry primer B28W300.
   b. Two (2) coats SW ProMar 200 interior latex (satin).

2. Interior Drywall.
   a. One (1) coat SW High Build latex primer.
   b. Two (2) coats SW ProMar 200 interior latex (satin).

3. Interior Drywall (epoxy coating).
   a. One (1) coat SW PrepRite 200 latex primer.
   b. Two (2) coats SW Water Based Catalyzed Epoxy (semi gloss).

4. Concrete block masonry; concrete.
   a. One (1) coat SW latex block filler.
   b. Two (2) coats SW ProMar 200 interior latex (semi loss).

5. Wood trim and doors painted.
   a. One (1) coat SW Preprite Easy Sand oil primer.
   b. Two (2) coats SW Pro Classic oil (gloss).

6. Wood trim and doors stained and varnished.

   a. One (1) coat SW Wood Classics wood stain.
   b. Two (2) coats SW Wood Classic Polyurethane (semi gloss).

END OF SECTION 099123

SECTION 101400 IDENTIFICATION DEVICES

1.1 GENERAL

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

B. This Section includes the following type of Identification Devices:

1. Interior directional and identification signage (room identification).

a. It is the intent of this project that every interior and certain selected exterior doors receive a room identification sign, whether listed on the door schedule or not. Insure that bid includes identification signs for every interior door. Room names will be verified and supplied by the Owner prior to fabrication.

C. Submittals:

1. Signage schedule in manufacturer's format for verification of text/copy.
2. Approval drawings showing materials, construction detail, lay-out, copy, size and mounting methods.
3. Engineering drawings for each sign type.
4. Sample of two sign types for verification of materials, color, pattern, overall quality, and for adherence to drawings and requirements indicated.

D. Quality assurance.

1. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

2. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

E. Warranty:

1. Provide manufacturer’s warranty against defects in materials and workmanship for minimum 5 years.

1.2 PRODUCTS

A. Manufacturers

1. Signage shall be Fusion as manufactured by Takeform, 1.800.528.1398, www.takeform.net or Architect approved equal.

2. Substitutions: Bidder must obtain prior written approval from the Architect and/or Owner to bid alternates or substitutions to the specification.

B. SIGN STANDARDS

A. It is the intent of these specifications to establish a sign standard for the Owner including but not limited to primary and secondary directories, wall mounted and overhead directionals, flag mounted directionals, primary room identification, restrooms, conference room, work station ID's and all code compliant signage. While the Owner may not obtain all signs and sign types, the signage contractor shall design and submit approval drawings for all.

B. Typography:
1. Type style: see drawings. Copy shall be a true, clean, accurate reproduction of typeface(s) specified. Upper and lower case or all caps shall be as indicated in Sign Type drawings and Signage Schedule. Letter spacing to be normal and interline spacing shall be set by manufacturer.
2. Arrows, symbols and logo art: To be provided in style, sizes, colors and spacing as shown in drawings.
3. Grade II Braille utilizing perfectly round, clear insertion beads.

C. Color and Finishes:
1. Colors, patterns and artwork: see drawings.
2. Message Background: see drawings.
3. Finishes are to meet current federal ADA and all state and local requirements.

2.3 SIGNS

A. Signage System:
1. The signage shall incorporate a decorative laminate face with applied graphics including all tactile requirements in adherence to ADA specifications.
2. All signs, including work station and room ID's, overheads and flag mounts, directionals and directories shall have a matching appearance and constructed utilizing the same manufacturing process to assure a consistent look throughout.

B. Materials:
1. Sign face shall be 0.035" (nominal) standard grade, high pressure surface laminate. A painted sign face shall not be acceptable.
2. The sign shall incorporate balanced construction with the core sandwiched between laminates to prevent warping. Laminate on the sign face only shall not be acceptable.
3. Tactile lettering shall be precision machined, raised 1/32", matte PETG and subsurface colored for scratch resistance.
4. Signs shall incorporate a metal accent bar. Bars shall be anodized with a brushed satin finish. Painted bars shall not be acceptable. Refer to drawings.

C. Standard Colors:
   1. Face/background color shall be standard grade, high pressure laminate, all colors and finishes. Refer to drawings.
   2. Standard tactile colors shall match manufacturer's ADA standard color selection. Refer to drawings.

D. Construction:
   1. The signage shall, with the exception of directories and directionals, be a uniform 8 ½" width to facilitate inserts printed on standard width paper.
   2. Insert components shall have a .080 thickness non-glare acrylic window and shall be inlaid flush to sign face for a smooth, seamless appearance.
   3. The signage shall include modules allowing for inserts, notice holders, occupancy sliders, marker, magnetic, and cork boards. All modules shall be flush to sign face for a smooth, seamless appearance.
   4. The laminates (front and back) shall be pressure laminated and precision machined together to a 90-degree angle. Edges shall be smooth, void of chips, burrs, sharp edges and marks.
   5. The signage shall utilize an acrylic sphere for Grade II Braille inserted directly into a scratch resistant, high pressure laminate sign face. Braille dots are to be pressure fit in high tolerance drilled holes.
   6. Braille dots shall be half hemispherical domed and protruding a minimum 0.025".
   7. The signage shall utilize a pressure activated adhesive. The adhesive shall be nonhazardous and shall allow for flexing and deflection of the adhered components due to changes in temperature and moisture without bond failure.
   8. All signs shall be provided with appropriate mounting hardware. Hardware shall be finished and architectural in appearance and suitable for the mounting surface.
   9. Some signs may be installed on glass. A blank backer is required to be placed on the opposite side of the glass to cover tape and adhesive. The backer shall match the sign in size and shape.

E. Printed Inserts:
   1. The signage shall be capable of accepting paper or acetate inserts to allow changing and updating as required. Insert components shall have a 0.080" thickness non-glare acrylic window and shall be inlayed flush to sign face for a smooth, seamless appearance.
   2. The signage contractor shall provide and install all signage inserts.
   3. Manufacturer shall provide a template containing layout, font, color, artwork and trim lines to allow Owner to produce inserts on laser or ink jet printer. The template shall be in an Acrobat or Word format (.pdf).

F. Quantities:
   Code and Facility Signage:

Sign Type E	Stairs	See Floor Plans
Sign Type E.2	Restroom	See Floor Plans
Sign Type G	Misc. Room ID	Rm 116-120, 142A, 142B, 143-151, 216-218, 222-225, and 234
Sign Type F	Room ID	At all Bunk Rooms
Sign Type H	Room ID Changeable Insert	At all Other Rooms

Sign Type J	Conference Room	For Conference Rooms

3.1 EXECUTION

A. Site visits – up to 3 site visits shall be required by the sign contractor:
   1. Prior to submission of bid for site assessment and evaluation.
   2. Post award for the purposes of meeting with Owners and project manager.
   3. Final walk-through and punchlist.

B. Programming – sign contractor shall perform all wayfinding & programming. Programming shall include location plan, message schedule, and/or plots, fire/evacuation maps and insert graphics. All programming materials shall be submitted for approval.

3.2 CODE COMPLIANCE

A. It shall be the responsibility of the successful bidder to meet any and all local, state, and federal code requirements in fabricating and installing signs.

3.3 DELIVERY, STORAGE, PROTECTION

A. Package to prevent damage or deterioration during shipment, handling, storage and installation. Products should remain in original packaging until removal is necessary. Store products in a dry, indoor location.

3.4 EXAMINATION

A. Installer shall examine signs for defects, damage and compliance with specifications. Installation shall not proceed until unsatisfactory conditions are corrected.

3.5 INSTALLATION

A. General: Installation locations shall be in accordance with ADA specifications. Locate signs where indicated using mounting methods in compliance with manufacturer's written instructions:
   1. The signage contractor shall coordinate installation schedules with the Owner and/or Construction Manager.
   2. Installation shall be performed by manufacturer’s personnel trained and certified in manufacturer’s methods and procedures.
   3. The signage contractor shall submit a CAD generated location plan noting the location of all signage and cross referenced to message schedule or plots for architect’s approval.
   4. Installer to conduct a pre-installation survey prior to manufacturing to verify copy and sign location. Each location shall be noted using a low tack vinyl reproduction of actual sign. Full scale renderings of directories and directionals shall also be provided. Any location discrepancy or message issues shall be submitted to architect for review.
   5. Signs shall be level, plumb, and at heights indicated with sign surfaces free from defects.
   6. Upon completion of the work, signage contractor shall remove unused or discarded materials, containers and debris from site.

3.6 STANDARDS MANUAL

A. Manufacturer shall provide a comprehensive Standards Manual in both a paper and PDF format. The manual shall include all graphic standards, sign type descriptions, renderings showing color, pattern and finish, engineering drawings, location plans, plots, artwork, insert templates, mounting detail, and reorder information.

END OF SECTION 101400

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE AND PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast dimensional characters letters.
2. Cast Aluminum Plaques

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs and plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size

C. Samples: For each exposed product and for each color and texture specified.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.3 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs 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 DIMENSIONAL LETTER SIGNS, GENERAL

A. Refer to drawings for type, location, font, size, etc.

2.2 PLAQUES

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. Advance Corporation; Braille-Tac Division.
2. A. R. K. Ramos.
3. Gemini Incorporated.
4. Matthews International Corporation; Bronze Division.
5. Metal Arts; Div. of L&H Mfg. Co.
6. Mills Manufacturing Company.
7. Nelson-Harkins Industries.
8. Southwell Company (The).

B. Cast Plaques: Provide castings free of pits, scale, sand holes, and other defects, as follows:

1. Plaque Material: Aluminum.
2. Background Texture: Manufacturer's standard leatherette texture.
3. Border Style: Square, polished.
4. Mounting: Concealed studs, non-corroding for substrates encountered.

2.3 DIMENSIONAL CHARACTERS & LETTERS

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 Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. A. R. K. Ramos.
4. ASI-Modulex, Inc.
5. Bunting Graphics, Inc.
6. Charleston Industries, Inc.
7. Gemini Incorporated.
8. Grimco, Inc.
9. Innerface Sign Systems, Inc.
10. Metal Arts; Div. of L&H Mfg. Co.
11. Mills Manufacturing Company.
12. Mohawk Sign Systems.
13. Nelson-Harkins Industries.
14. Signature Signs, Incorporated.
15. Southwell Company (The).

B. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
1. Character Material: Cast aluminum
2. Character Height: 12”
3. Finishes: Anodized mill finish

4. Mounting: Concealed studs

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace signs for stability and for securing fasteners.
5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 ALUMINUM FINISHES

A. Color Anodic Finish: Manufacturer's standard Class 1 integrally colored or electrolytically deposited color anodic coating, 0.018 mm or thicker, in black applied over a nonspecular as fabricated mechanical finish, complying with AAMA 611.

B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

2.7 Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

C. Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.

D. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

E. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 102113 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures entrance screens and urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

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. Ampco Products, LLC.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced

C. Entrance-Screen Style: Overhead braced

D. Urinal-Screen Style: Wall hung

E. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.

F. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

G. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, clear-anodized aluminum

H. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range
3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: Clear-anodized aluminum.
2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113

SECTION 102219 – DEMOUNTABLE PARTITIONS

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. Non-progressive, movable and reconfigurable system of unitized or pre-assembled panels, from a single manufacturer
2. Trim, Sealants, Hardware and Accessories.

B. Products supplied but not installed under this Section: Voice/data cabling, devices, faceplates for thermostats and other devices.

1.3 RELATED SECTIONS
1. Flush Wood Doors – Section 081416
2. Door Hardware – Section 087100
3. Glass and Glazing – Section 088000
4. Acoustical Ceilings – 095110
5. Electrical and Lighting– Division 26

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has successfully completed demountable partition installations similar in material, design, and extent to that indicated for this Project and is mutually accepted by the manufacturer and the customer.

B. Genius Architectural Performance Requirements:
1. Structural Performance: Provide demountable partitions capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   a. Load-Bearing Capacity of Panel System: Not less than 7 lbs. / linear inch (3.175 kg/ 25.4 mm) distributed proof load when tested according to BIFMA X 5.6, Section 03, Table 06.
   b. Transverse-Load Capacity of Panel System:
      1) Interior wall panel deflections shall not exceed 1/120 of the span for flexible facing material or 1/240 of the span for brittle facing materials under a 5 psf (0.240 kN/m²) uniform transverse design load per the 2012 IBC Table 1604.3. Interior wall panel deflections for glass panel frames shall not exceed 1/175 of the span or 0.75 inches, whichever is less under a 5 psf (0.240 kN/m²) uniform transverse design load per the 2012 IBC Table 1604.3.
      2) 2012 IBC Section 1607.14: Interior demountable partition or butt-glazed entrances/storefronts wall products that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength to resist the loads which they are subjected but not less than a horizontal load of 5 psf (0.240 kN/m2).
      3) Seismic Performance: Provide demountable partitions capable of withstanding the effects of earthquake motions determined according to ASCE 7 – Minimum Design Loads for Buildings and Other Structures.

4) Office of Statewide Health Planning and Development Anchorage pre-approval number is OPA-2608-10 and conforms to the 2010 California Building Code.

2. Sound Control: Solid panels shall provide an overall sound transmission class of not less than 44 STC rating in accordance with ASTM E-90, ASTM E412 when recessed ceiling channel, recessed panel connectors and wallposts are used. Solid panels shall provide an overall sound transmission class of not less than 48 STC rating in accordance with ASTM E-90, ASTM E412 when flush ceiling channel, flush panel connectors and U-channels are used.
3. Fire Retardancy: No flammable materials shall be used in the manufacture of the wall system. Provide independent laboratory tests for surface-burning characteristics of panel finishes in accordance with ASTM E-84. Flame Spread: Class A for powder coat finish and steel.
4. Electrical Components, Devices and Accessories: UL listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
5. Indoor Air Quality: Demountable partition wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting ANSI/BIFMA M7.1-2011, California Specification 01350, and ANSI/BIFMA e3-2012 testing, conducted in an independent third-party air quality testing laboratory.
6. FSC Chain of Custody Certification number is SCS-COC-002476.
7. Clean Room Approval: Demountable wall manufacturer must be approved for use in cleanrooms. According to CSI Testing, the selected manufacturer met or exceeded the 10,000 clean area class conditions in accordance with Federal Standard 209E and ISO 14644 Part I: Institute of Environmental Sciences RP-006.2 and/or the National Environmental Balancing Bureau Procedural Standards for Cleanrooms.

C. Lightline Architectural Performance Requirements:
1. Sound Control: Glass panel's sound transmission will be dependent upon glass type used.
2. Indoor Air Quality: Demountable partition or butt-glazed entrances/storefronts wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting ANSI/BIFMA M7.1-2011, California Specification 01350, and ANSI/BIFMA e3-2012 testing, conducted in an independent third-party air quality testing laboratory.
3. Glass Association of North America (GANA) Guidelines: Recommends the use of ½" thick glass when used in butt-glazed demountable partition or entrances/storefronts mounted or restrained at the top and bottom only for ceilings from 96" to 120".
4. 2012 IBC, Section 2403.4: When two adjacent interior demountable partition or butt-glazed entrances/storefronts walls mounted or restrained at the top and bottom only are installed adjacent to a walking surface, the differential deflection shall not be greater than the thickness of the panels (glass thickness) when a force of 50 pounds per linear foot is applied horizontally to one panel at any point up to 42 inches above the walking surface.
5. 2012 IBC Section 1607.14: Interior demountable partition or butt-glazed entrances/storefronts wall manufacturer that exceed 6 feet (1829 mm) in height, including their finish materials, shall have adequate strength to resist the loads which they are subjected but not less than a horizontal load of 5 psf (0.240 kN/m2).

D. Combustibility Performance: Product shall have finishes and construction acceptable for use in Non-Combustible buildings, in accordance with Chapters 6 and 8 of the International Building Code, 2012 Edition.

E. 2010 ADA:

Doors Clear Width (ADA 404.2.3) *Suggested Specification.* Doorways shall have a minimum clear opening of 32" (815mm) with the door open 90°, measured between the face of the door and the opposite stop, and shall have 80" (2030mm) minimum clear headroom

Doors Opening Force (ADA 404.2.9) *Suggested Specification.* Interior hinged, sliding or folding doors shall require no more than five pounds of force to open.

Doors Door Hardware (ADA 404.2.7) *Suggested Specification.* Door handles shall be levers that can be operated with a closed fist. Hardware shall be mounted no higher than 48” (1220mm) above finished floor and a minimum of 34” above finished floor.

Office Layout Wheelchair Turning Space (ADA 304.3) *Suggested Specification*. Allow 60” (1525mm) diameter clear space within office to allow a wheelchair to make a 180° turn.

F. Certification: Include supporting certified laboratory testing data indicating that material meets specified test requirements.

G. Mock up for Verification Purposes: In a location designated by the Architect, install a full scale installation incorporating at least one of each type of panel, and accessory required, illustrating each installation condition. Retain mock up installation until completion of total installation or dismantle earlier at the direction of the Architect. Materials used for the mock up installation will not be considered part of either the base contract materials or the attic stock materials. If life cycle costs of the product are an important decision criteria, the mock up installation and reconfiguration should be timed, and the reuse of components should be evaluated.

1.5 DESIGN REQUIREMENTS

A. Genius Design Requirements

1. The extent of the demountable partition work as shown on the drawings, and as specified herein.
2. Provide all materials, labor, and equipment to install demountable partitions. The demountable wall system shall offer maximum flexibility and reusability to accommodate frequent and quick relocation work without loss of materials, damage or modification to panels or to adjoining structures such as ceilings, fixed walls and floors. The factory assembled system must be unitized or pre-assembled (not stick built), non-progressive and modular, allowing the removal of individual panels from any location without disturbing adjoining units and providing interchangeability of panels and door units on the same module.
3. The system can offer a single center reveal design with optional concealed vertical slotting for wall-hung furniture components utilizing a pliable recessed panel connector. A shallow panel connector between panels provides a single center reveal design which matches the finish of the panel face, or a flush connector finished to match the panel to provide a monolithic aesthetic.
4. The head detail is either recessed or flush.
5. The base assembly with an integrated leveling system shall be permanently attached to the panel. Detached and loosely shipped floor tracks and leveling components shall not be permitted.
6. The solid panels shall be available in a choice of finishes and substrates to include marker board steel, wood veneer, powder coated steel, vinyl-covered steel fabric-covered steel, fabric-covered tack board. (For acoustic purposes, no gypsum or melamine type product will be used.)
7. Panels are stackable (top or bottom) to accommodate ceiling height changes and panel type changes (i.e., solid/glass or glass/solid configurations).
8. Factory installed panel shells or faces shall be removable and interchangeable in the field without dismantling as complete units.
9. The factory assembled demountable walls should very flexible to accommodate the building conditions. The demountable wall should have flexible vertical adjustability. An adjustable, u-channel head assembly shall provide a ± 1/2" adjustment at the ceiling. At the floor, a self-contained leveling glide system and a flush 4"-, or 5"-high base cover shall allow for an adjustment of ± 1" for a 4” base and ± 1 ½” for a 5” base. Combined, this shall provide an overall vertical adjustment of ± 1 1/2" for 4” and ± 2” for 5” to compensate for ceiling and floor irregularities. Where the wall system meets the building core walls, columns or window mullions, a telescopic, spring-loaded wall post or u-channel shall allow for a ±1" horizontal adjustment. All products shall be able to accommodate incremental sizes to a 1/16 IN increments.

10. Compatible modular power shall be available and can terminate within the solid wall panel and base areas of both glass and solid panels (overlapping 5” base only). All modular power connections within solid walls cavities and base areas shall be accessible and inspectable before, during and after installation. Owner will require open accessibility to power and data cabling disconnection and reconnection and pathways to accommodate wall disassembly + relocation. Walls shall be able to be field retrofitted to accept additional modular power outlets and conventional hardwired electrical outlets, fire + life safety, ADA strobes + devices, thermostats, and access security hardware and devices without complete wall section removal.

B. Lightline Design Requirements

This Section includes the following:

1. The extent of the demountable partition or butt-glazed entrances/storefronts work as shown on the drawings, and as specified herein.
2. Provide all materials, labor, and equipment to install demountable partitions or butt-glazed entrances/storefronts. The system shall offer maximum flexibility and reusability to accommodate frequent and quick relocation work without loss of materials, damage or modification to panels or to adjoining structures such as ceilings, fixed walls and floors. The factory assembled system must be unitized or pre-assembled (not stick built), non-progressive and modular, allowing the removal of individual panels from any location without disturbing adjoining units and providing interchangeability of panels and door units on the same module.
3. The head detail shall be flush to the ceiling without a reveal. All ceiling leveling adjustment is hidden within the head detail.
4. The panel thickness at the base shall be 2” thick providing the user more usable space when space planning.
5. The base assembly with an integrated leveling system shall be permanently attached to the panel. Detached and loosely shipped floor tracks and leveling components shall not be permitted.
6. The factory assembled movable walls should very flexible to accommodate the building conditions. The wall shall have flexible vertical adjustability. An adjustable, ceiling head assembly shall provide a ± 1/2" adjustment at the ceiling. At the floor, a self-contained leveling glide system and a 2 ½”, 3 ¼” and 4” high base cover shall allow for floor adjustment of + 1/4” for a 2 ½” base, + 1” for a 3 ¼” base, and 1 3/4” for a 4” base. Where the wall system meets the building core walls, columns or window mullions, u-channel extrusions shall allow for horizontal adjustment.

1.6 SUBMITTALS

A. Product Data: Product data on physical characteristics, durability, resistance to fading, and flame spread characteristics for each type of partition and accessory.

B. Shop Drawings: Shop drawings showing location and extent of partitions. Include plans, elevations, sections, details, and attachments to other work.

C. Samples:

1. Samples for Initial Selection: Samples for initial selection purposes in form of manufacturer’s standard color charts showing full range of colors, textures, and patterns available for each type of material exposed to view.
2. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   a. Panel Finish Face: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.
   b. Base Trim: 12-inch- (300-mm-) long Samples.
   c. Door Finish Face: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.
   d. Glazing: Manufacturer's standard-size unit, but not less than 3 inches (75 mm) square.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of demountable partition.

E. Contract Closeout Information:
   1. Warranty.
   2. Maintenance Data: For demountable partitions to include in maintenance manuals.
      a. Recommended cleaning materials and warnings about cleaning methods that could be detrimental to finishes and performance.
      b. Installation manual detailing methods to move reuse and adjust demountable product.

F. Environmental Information:
   1. LEED Credit MR 4.1 or 4.2, Recycled Content: Product data indication percentages by weight of post-consumer and post-industrial recycled content for products having recycled content; includes statement indicating costs for each product having recycled content.
   2. LEED credit MR 5.1, Local/Regional Materials: Manufacturer's certification indicating final point of assembly for products and materials located within 500 miles of Project Site. Include manufacturer's name, address and phone number.

1.7 PROJECT CONDITIONS

A. Delivery, Storage, and Handling: Deliver materials to Project Site in original factory wrappings and containers/skids, clearly labeled with identification of manufacturer, brand name, model number and order number. Store materials in original undamaged packages and containers, inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; store product according to installation manual and away from other trades.

B. Environmental Limitations: Do not deliver or install demountable partition components until building is enclosed and finishing operations, including ceiling and floor-covering installation and painting, are complete.

C. Field Measurements: Indicate measurements on Shop Drawings.

D. Coordination of Work: Coordinate layout and installation of demountable partition components with other units of Work. Installation of ceilings, floor coverings, lighting fixtures, HVAC equipment, and fire-suppression systems should be completed before demountable partitions are installed.

E. Special Requirements: Comply with instructions and recommendations of manufacture for special delivery, storage, and handling requirements.

1.8 EXTRA MATERIALS

Deliver to the Owner, not less than <u>three</u> percent of the Project total for each component, panel and accessory of each type, color, and finish of demountable partition system exclusive of material required to properly complete installation. Furnish accessory components and installation tools as indicated on schedule. Furnish extra materials from same production run as materials installed. Package extra materials with protective covering, identified with appropriate labels.

1.9 WARRANTY

Demountable system glazed units, door frames, and related components to be without defects in material or workmanship for a period of ten (10) years from the date of delivery. Wood doors shall be warranted for ten (10) years from the date of delivery, subject to the manufacturer's terms and conditions. Third party supplied product such as door hardware and film applied to glass will be warranted based on their own

warranty terms.

This warranty does not cover defects or damage resulting from accidents, misuse, improper relocation methods or transfer to storage. Plastic laminates, and wood veneer finishes are not warranted against fading or wearing, or if improperly cleaned or treated by the Owner or by others.

1.10 NON-OBSOLENCE

Demountable system components and parts, with exception of third party supplied product (such as door hardware, glass, film applied to glass) are guaranteed to be compatible and available for purchase for ten years from the date of the original order.

PART 2 - PRODUCTS

2.1 DEMOUNTABLE PANEL PARTITIONS

A. Products: Subject to compliance with requirements, provide the Basis-of-Design Product.

1. Basis-of-Design Product: Subject to compliance with requirements, provide KI “Genius Wall” and “Lightline”.

B. Genius Solid Panels With Steel Substrate: 8.89cm (3 ½”) thick and consisting of an aluminum extruded frame construction, two removable panel shell assemblies each composed of one sheet of 22-guage steel glued to vertical / horizontal stiffeners and intermediate horizontal stiffeners, non-toxic fiberglass insulation, and the base assembly. Top of panel engages the ceiling channel. Aluminum frames (including glass panels) as a standard will have cavities on each side to accommodate cabling. Field notching the horizontal frame members will also allow easy cable access from the ceiling or the floor. As standard, solid panel vertical frame posts can be slotted for hang-on furniture and the slots concealed by a dual durometer PVC gasket which is 1" wide and recessed from panel face or by a flush-to-panel face connector. Component bracketry is optional. Panels to contain integral, adjustable bottom connectors, and the panel shells to be equipped with a mushroom-shaped extrusion that forms a compression fit with the vertical frame for easy removal from the frame structure.
1. Type: Factory finished.
2. Panel Thickness: Manufacturer's standard, 3 ½” thickness.
3. Panel Width: As indicated on drawings.
4. Panel Finish: Powder-coat finish
5. Panel Color and Pattern: As selected by Architect from manufacturer’s full range.
6. Magnetic Accessory: tbd

C. Genius Aluminum Glass Framing:
1. Frame Finishes: Factory-applied powdercoat paint
2. Frame Color: As selected by Architect from manufacturer’s full range
3. Glass Frame Vertical Dimension: 1.9”
4. Glass Panel Configuration: Single Center mounted

D. Genius Panel Connector or Joint Closure:
1. Connector Type: Flush
2. Finish: As selected by Architect from manufacturer’s full range

E. Genius Trim: Base trim is continuous, factory-finished, snap-on type or recessed; adjustable for variations in floor. Ceiling trim is continuous and compensates for ceiling irregularities.
1. Base Trim Profile: Flush
2. Flush Base Trim Height: 4”

3. Ceiling Trim Profile: Recessed
4. Exposed-Metal Trim Finish: Factory-applied powdercoat paint
5. Trim Color: As selected by Architect from manufacturer's full range

F. Genius Wood Door Leaves: Manufacturer's standard 5-ply construction and 1-3/4 inches (45 mm) thick. Leaves should be constructed with no visible stop. Standard core material is Timberstrand which is considered a rapidly renewable material.
1. Door Veneer Type: Oak – Rift Cut
2. Door Veneer Finish: See section 081416 Flush Wood doors for required finishes
3. Door Leaf Type: Fully-Glazed with ¼" clear tempered glass
4. FSC Veneer: No

G. Genius Door Frames: Manufacturer's standard aluminum extrusion, factory- machined to receive hardware, for 1-3/4-inch (45-mm) doors.
1. Frame Finishes: Factory-applied powdercoat paint.
2. Frame Color: As selected by Architect from manufacturer's full range
3. Frame Height: Ceiling height
4. Frame Type: Single Sliding, Single butt-hung, and Double butt-hung

H. Genius Door Hardware: As specified in Hardware Section 087100

I. Genius Glass and Glazing: Safety glazing in compliance with Glass and Glazing – Section 088000.
1. Single Glazed Thickness: 1/4"
2. Glass Type: Tempered

J. Genius Electrical and Communications: As specified in Electrical – Division 26 and Communications – Division 27. All electrical components are UL listed and approved.

K. Genius Solid Panel Acoustical Rating: STC 44

L. Lightline Butted Glass Panel-to-Panel Glazing Seal:
1. In-line Joint Seal Type: Factory-installed VHB tape dry glass seal and ¼" rigid seal
2. Frameless Corner Glass Overlap (not-mitered) Glazing Seal Type: Factory-installed VHB tape dry glass seal and 1/8" rigid seal

M. Lightline Glass and Glazing: Safety glazing in compliance with Glass and Glazing – Section 088000.
1. Single Glazed Thickness: ½"
2. Glass Type: Tempered
3. Exposed Glass Edge Type: Polished and Aris (chamfered)
4. Glass Panel Configuration: Single Center mounted

N. Lightline Aluminum Trim: Base trim is continuous to 10', factory-finished, snap-on type or recessed; adjustable for variations in floor. Ceiling trim is continuous to 10' and ceiling irregularities are hidden.
1. Base Trim Height: 4"
2. Ceiling Trim Profile: 3" Flush
3. Exposed-Metal Trim Finish: Factory-applied powdercoat paint
4. Trim Color: As selected by Architect from manufacturer's full range
5. Typical Corner Ceiling Trim: Outside corner is factory mitered and are 2 ½" x 2 ½". Inside corner is a butt-joint.
6. Typical Corner Base Trim: Outside corner is factory mitered and are 2 ½" x 2 ½". Inside corner is a butt-joint.

O. Lightline Post Connections:
1. Universal Post Configuration Demising Wall. Please denote typical wall connection: 3 ½" Genius Wall]
2. Permanent Drywall Connection (Connection sealed with gasket): U-Channel

P. Lightline Wood Door Leaves: Manufacturer's standard 5-ply construction and 1-3/4 inches (45 mm) thick. Leaves should be constructed with no visible stop. Standard core material is Timber strand which is considered a rapidly renewable material. Standard stile/rail thickness is 5”.
   1. Door Veneer Type: Oak – Rift Cut
   2. Door Veneer Finish: Refer to Section 081416 Flush Wood Doors for finish requirements.
   3. Door Leaf Type: Fully-Glazed with ¼” clear tempered glass
   4. FSC Veneer: No

Q. Lightline Type of Door Frame: Sliding door frame track is surface-mounted and finished with a valence. Optional double acting soft stop mechanism is available. Pivot hinge is reversible. Door frame units are pre-assembled or unitized.
   1. Frame Height: Ceiling height
   2. Frame Type: Single Reversible Pivot
   3. Frame Finishes: Factory-applied powdercoat paint
   4. Frame Color: As selected by Architect from manufacturer’s full range
   5. Vertical Post Size: 2 1/8”
   6. Optional Door Seal on vertical posts and along horizontal top: No

R. Seals: Manufacturer's standard.

2.2 FABRICATION

A. Demountable Panels: Factory-assembled, flush, hollow unit construction; with faces smooth and free of buckles, oil canning, and seams; and insulated with solidly packed, formaldehyde free insulation. Fabricate panels for installation with concealed fastening devices and pressure-fit components that will not damage ceiling or floor coverings. Fabricate panels with continuous light-and-sound seals at floor, ceiling, and other locations where panels abut fixed construction.

   1. Factory glaze panels to the greatest extent possible.

B. Butt-glazed entrance/storefront panels: Factory-assembled, butt-glazed pre-assembled glass units (not stick-built or site built). Fabricate panels for installation with concealed fastening devices and pressure-fit components that will not damage ceiling or floor coverings. Fabricate panels with continuous light-and-sound seals at floor, ceiling, and other locations where panels abut fixed construction.

C. Components: Fabricate components for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate for installation with continuous seals at floor, ceiling, and other locations where partition assemblies abut fixed construction and for installation of sound attenuation insulation in partition cavities.

2.3 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation of demountable partition system, clean floor to remove dust, debris, and loose particles.

B. Illuminate areas of installation to provide an ambient light level of at least 100 foot candles measured in the area where partitions are to be installed.

C. Maintain temperature in the area of installation at a constant minimum of 65 degrees F with relatively humidity less than 70 percent for a period of 48 hours prior to installation and during installation process.

D. General Contractor will deliver all GWB construction interfacing with the demountable partition system in true and plumb condition.

E. For manufacturer to accept responsibility of dimensional compatibility between demountable partition wall system and GWB construction, manufacturer shall have access to the completed GWB for accurate field measuring eight weeks prior to requiring product on site to commence installation. If time line does not permit the eight weeks lead time, demountable manufacturer shall provide “hold-to” dimensions for the General Contractor. General Contractor then assumes responsibility that GWB construction delivers on “hold-to” dimensions.

F. Demountable manufacturer determines that conditions are acceptable to receive the work of this section. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting of work shall be construed as acceptance of conditions.

3.2 INSTALLATION

A. Install demountable partition systems rigid, level, plumb, and aligned. Install seals to prevent light and sound transmission at connections to floors, ceilings, fixed walls, and abutting surfaces.

1. Installation Tolerance: Install each demountable partition so surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent partitions.

B. Do not alter ceiling suspension system.

C. Install door-and-frame, solid panel and frame, and glazing-and-glazing-frame assemblies securely anchored to partitions and with doors aligned and fitted. Install and adjust door hardware for proper operation.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate and train Owner's maintenance personnel to adjust, operate, and maintain demountable partitions. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 102219

SECTION 102800 TOILET ROOM ACCESSORIES

1.1 General

A. Submittals

1. Shop drawings: Submit shop drawings showing details, rough openings for recessed accessories, finishes, dimensions, and anchor and fastener method as well as manufacturer's literature including specifications and printed installation instructions.
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B. Coordination

1. See Drawings for floor plans and elevations of types referenced within this Section.
2. NOT ALL ITEMS LISTED IN THIS SECTION WILL BE SPECIFICALLY IN TOILET AREAS.

1.2 Products (qty)

A. Framed Mirrors (8)

1. Type: Framed.
2. Product: Bobrick B-165 1830, one-fourth (1/4) inch float glass.
3. Material: Stainless steel, bright polished, welded corners.
4. Guaranty: Ten (10) year minimum against silver spoilage.
5. Size: 18" wide x 30" high, where shown on Drawings.

B. Grab Bar - toilets (6-36, and 6-42)

1. Product(s): Bobrick B-6806 – 36, and B-6806 – 42
2. Material: Stainless steel, satin finish.
3. Mounting: Concealed fasteners.

C. Grab Bar - Shower (5-custom)

1. Product(s): Equal to Bobrick B-6861 three sided, refer to plans.
2. Material: Stainless steel, satin finish.
3. Mounting: Concealed fasteners.

D. Soap Dish (8)

1. Product: Bobrick B-4380.
2. Material: Stainless steel, satin finish.
3. Mounting: Recessed.

E. Surface Toilet Paper Dispenser (8)

1. Product: Bobrick B-2740 Double roll dispenser.
2. Material: Cast aluminum with satin finish.

3. Mounting: Mount as recommended by manufacturer. See drawings for location.

F. Surface Mounted Soap Dispenser (2)

1. Product: Bobrick B-4112
2. Material: Type 304, 20 gauge stainless steel with satin finish.
3. Mounting: Wall surface mounted.

G. Surface Paper Towel Dispenser (11) – Final locations to be determined by the Architect.

1. Product: Bobrick B-262
2. Material: Stainless steel with satin finish on all exposed surfaces.
3. Mounting: Surface.

J. Robe Hook (12) – Coordinate final mounting locations with Architect.

1. Product: Bobrick B-6717
2. Material: Satin finish stainless steel.

K. Shower Curtain Rod (7) Sizes vary refer to plan for sizes.

1. Product: Bobrick B-207
2. Material: 18 gauge stainless steel tubing with satin finish.

L. Shower Curtain, bar and Hooks (7) {{confirm whether client wants shower curtains or shower enclosure as noted below}}

1. Product: Bobrick B-204 – coordinate size to comply with openings.
2. Material: Curtain to be opaque, matte white vinyl with Nickel plated brass grommets along top for installation of 18 gauge stainless steel hooks at no more than 6" on center. Curtail shall have bottom and sides hemmed and weighted. *GC shall coordinate size requirements with each shower prior to final order to insure size is as recommended by manufacturer.*

M. Janitor Closet Shelf (2)

1. Product: Bobrick B-239
2. Material: Stainless steel with satin finish on all exposed surfaces.
3. Mounting: Mounting brackets welded to shelf.

N. Recessed Medicine Cabinet (6)

1. Product: Bobrick B-398
2. Material: Stainless steel with all welded construction and ¼” float glass mirror door.
3. Provide with four adjustable shelves.

O. Shower Enclosure (6)

1. Frameless with clear tempered glass partition and door.

1.3 Execution

A. Installation

1. Install all accessories at locations indicated in accord with manufacturer's printed directions. Verify wall depth and accessory size to suit wall condition.

2. Secure accessories to supporting substrate with fasteners and anchors of types necessary for rigid anchorage to substrate construction.

3. Install accessories plumb and true with horizontal lines level. Conceal evidence of drilling and fitting in adjacent surfaces.

4. Mounting heights: In toilet rooms designed for the handicapped, mount applicable accessories at heights required by local, state, and federal codes.

B. Fasteners

1. Fabricate concealed mounting devices and fasteners from same material as particular accessory of galvanized steel.

2. Exposed mounting devices and fasteners finished to match particular accessory.

3. All fasteners to be theft-resistant type.

END OF SECTION 102800

SECTION 104400 FIRE EXTINGUISHERS AND CABINETS

1.1 GENERAL

A. Related Work Described in Other Sections

1. Gypsum Wallboard Systems -Section 092900.
2. Unit Masonry – Section 042000
3. Stucco – Section 092400

B. Submittals: Submit manufacturer's technical literature and color finish samples to Architect for approval.

C. Coordinate required locations with structure to insure that they will fit at time of installation.

D. Project requires semi-recessed cabinets with extinguisher and bracket hung extinguisher units; and one (1) bracket hung wet chemical extinguisher for kitchen area, refer to plans for location.

1.2 PRODUCTS

A. Fire Extinguishers:

1. General purpose (see plan for location): Larson MP-10 mufti-purpose dry chemical or Architect approved substitution.

2. UL Rating: 4A-60B:C.

3. Nominal capacity: Ten (10) pounds.

4. Kitchen: In addition to any general extinguisher requirements, provide additional extinguisher WC-6L on a wall bracket #1007 with wet chemical matching kitchen hood suppression system.

B. Cabinets; Recessed

1. Manufacturer: Larsen Manufacturing Company.

2. Type: Occult series D-2409 or Architect approved substitution.

3. Door style: Solid.

4. Die cut lettering: Black.

C. Wall Mounted extinguishers;

1. Where indicated provide extinguisher on bracket number 846 with each required and/or indicated extinguisher.

1.3 EXECUTION

A. Installation:

1. Clean extinguishers and protect from damage. Touch-up damage to pre-finished surfaces as required.

2. Install at locations indicated on drawings.

3. Fill and service all extinguishers prior to installation in project.

4. Install in accord with manufacturer's published instructions.

END OF SECTION 104400

SECTION 105113 – SPECIAL LOCKERS – BUNKER GEAR

1.1 GENERAL

A. RELATED DOCUMENTS

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

2. This section shall be regarded as minimum requirements for storage systems as manufactured by Mid-Minnesota Wire and Manufacturing, Inc. No substitutions allowed.

B. This section includes the provision of material and installation of the following:

1. Bunker gear storage lockers.

C. SUBMITTALS:

1. Submit product data and installation instructions for each type of metal locker units, and benches.

2. Shop Drawings:

a. Submit shop drawings for each type of metal lockers. Show material and construction for each type of lockers; include method of installation, fillers, trim, base and accessories. Include locker numbering sequence information. Include specified options.

3. Samples:

a. Finish Color: Red.

b. If requested by Architect, submit one full sized locker of each type required, demonstrating the quality of the proposed construction and finish, complete with required hardware and latching mechanism.

D. DESIGN CRITERIA:

1. Special Requirements:

a. Where specified in this section, modify standard construction methods and procedures to conform with special requirements listed.

1.2 PRODUCTS

A. BUNKER GEAR LOCKERS:

1. Sizes: Jumbo Size 24 inches wide by 20 inches deep by 74-1/2 inches high.

2. Manufacturer:

   a. Geargrid, a division of Mid-Minnesota Wire & Manufacturing, Inc. Forest Lake Minnesota. (888)643-6694 www.geargrid.com.

3. Accessories:

   a. Secure Doors: matching locker.

   b. Geardryer; stainless steel jacket holder.

   b. Gearglove; stainless steel glove holder.

4. Color: Powder coat - Red.

5. Quantity; see drawings for location and quantity.

1.3 EXECUTION

A. EXAMINATION

1. Do not proceed with the work of this section until conditions detrimental to the proper and timely completion of the work have been corrected in an acceptable manner.

B. INSTALLATION

1. Locker installation requires special clearances within room. Insure that all clearances are provided BEFORE finishes are completed.

2. Install lockers at locations indicated on the drawings in accordance with manufacturer's instructions for a plumb, level, rigid, and flush installation.

3. Touch-up marred finishes, or replace as directed, using materials and finishes as recommended or furnished by manufacturer.

END OF SECTION 105113

SECTION 107500 - FLAGPOLE

1.1 General

A. Description

1. Provide flagpole as specified in this Section.

B. Submittals

1. Submit shop drawings for each type of unit, including sections of members and dimensional elevations. Show anchors, grounds, reinforcement, accessories, and installation details.

2. Submit manufacturer's specifications and installation instructions for each material and component part including substrate.

C. Quality Assurance

1. Design flagpole and all components certified by a Florida Registered Engineer to resist un-flagged wind loads of up to one hundred fifty-five (155) miles per hour. Provide engineered calculations.

D. Approved Manufacturer

1. Concord Industries, Inc., 4150-A Kellway Circle, Addison, TX, (800) 527-3902. This manufacturer establishes the intended level of quality for flagpoles and provides the basis for the Architect's review of substitutions.

2. Morgan-Francis and Pole-Tech are approved equal. Other Substitutions will be considered during bid.

1.2 Products

A. Poles

1. Style: Concord Sentry system, continuous internal halyard system.

2. Aluminum (6063-T6), one (1) piece cone continuous taper seamless pipe.

3. Wall thickness: Minimum zero point one eighty eight (0.188) inch.

4. Exposed height: Thirty-five (35) feet exposed height plus required depth in ground for foundation.

5. Outside diameter: Sized according to height.

6. Finish: Duranodic, medium No. 312, final selection by Architect.

7. Double revolving truck, cast aluminum.

8. Two (2) cleats cast aluminum.

B. Flagpole Base

1. Foundation tube: Provide sixteen (16) gauge minimum galvanized corrugated steel tube, or ten (10) gauge rolled steel tube, sized to suit the flag pole and installation. Spun aluminum collar finished to match flagpole shaft.

2. Furnish complete with welded steel bottom base and support plate, lightning ground rod, and steel centering wedges, all welded construction.

3. Provide aluminum wedges at top for plumbing pole erection.

4. Finish: Galvanized steel parts, including foundation tube, after fabrication.

C. Flagpole Fittings And Accessories

1. Truck: Cast aluminum, with removable top cover for easy access to two (2) aluminum pulleys with sealed roller bearings on delrin axles.

2. Halyard: Provide continuous stainless steel cable with two (2) delrin flag holders and stainless steel flag holder separators between the flag holders. Provide halyard with an anti-furling device which prevents flag from entwining in halyard.

3. Flashing collar: FC-121, three and one-half (3-1/2) inch high and twenty-two (22) inches in diameter.

1.3 Execution

A. Installation: In accord with manufacturer's approved shop drawings and published instructions.

1. Coordinate foundation installation and setting of foundation sleeve with concrete work. Erect plumb and rigid in metal foundation sleeve cast in concrete foundation as indicated.

2. Seal top edge of flashing collars watertight to poles with polysulfide sealant.

3. Install all accessories and leave ready to use.

END OF SECTION 107500

SECTION 111100 - LAUNDRY EQUIPMENT

1.1 General

A. Related Work Described In Other Sections

1. Sections in Division 22 - Plumbing.

2. Sections in Division 26 - Electrical.

B. Coordination

1. Coordinate with all other trades to insure proper installation requirements including structural, electrical, plumbing, and ventilation. Failure to perform proper coordination will not be cause for additional cost to the Owner.

C. Submittals

1. Submit properly identified manufacturer's literature, including equipment specifications, performance data, operating instructions, and published installation instructions.

2. Provide cut sheets for equivalent alternate residential washer and dryer in the event that specified model has been discontinued.

1.2 Products (confirm availability at time of purchase)

A. Residential Washer: Provide and install one Whirlpool Washer, model number WTW8600YW, color white. Electrical requirements 120V/60Hz/20 amps, grounded.

B. Residential Electric Dryer: Provide and install one Whirlpool dryer, model number WED8800YW color white on white. Electrical requirements 120/208/240 volts/60 Hz/30 amps.

1.3 Execution

A. Installation: Install with all appurtenances and accessories in strict accord with approved shop drawings and manufacturer's published installation directions.

B. Execute all necessary mechanical and electrical service connections.

C. Upon completion insure full operation, and provide instruction and all operating manuals to the Owner. If lost, obtain replacements from manufacturer.

END OF SECTION 111100

SECTION 114000 - FOOD SERVICE EQUIPMENT

1.1 General

A. Related Work Described In Other Sections

1. Sections in Division 22 - Plumbing Connections.

2. Sections in Division 26 - Electrical Connections.

B. Submittals

1. Submit properly identified manufacturer's literature, including equipment specifications, performance data, operating instructions, and published installation instructions.

2. Submit shop drawings for review and approval showing dimensions, locations, mechanical and electrical stub out data and locations, accessories, and installation procedures.

C. Connections

1. Confirm and coordinate all required infrastructure with mechanical, electrical, and plumbing B whether indicated on the drawings or not.

1.2 Products

A. Quantity of one 36" deep, gas oven/range Model No. S60-6R24RR Raised Griddle/ Broiler Gas Range, SunFire Series, 60" Restaurant, Gas, (6) 30,000 BTU open burners, 24" Griddle, two standard ovens, stainless steel front, sides, and backguard with high shelf, 6" NSF aluminum legs. Range will be regulated for Natural Gas.

B. Kitchen Ice maker/Dispenser by Hoshizaki model # DCM-270BAH – Substitutions will be considered only if approved prior to bid. Power requirements 115V/60/1. Quantity of one (1).

C. Refrigerator by LG – 23.8 Cu. Ft
Model Number LBC24360SW. Quantity of three (3)

E. Dishwasher to be Whirlpool ADA height compliant Model No. WDT920SADM Whirlpool Gold® Dishwasher with TotalCoverage Spray Arm Monochromatic Stainless Steel. Provide 140 degree water temperature. Provide 20A, 120V, 60HZ on dedicated circuit. Quantity of one (1).

1.3 Execution

A. Installation: Install with all appurtenances and accessories in strict accord with approved shop drawings and manufacturer's published installation directions.

B. Execute all necessary mechanical, plumbing, and electrical service connections as needed for a full operating system.

C. Leave all equipment ready for Owner use.

D. Provide the Owner with complete warranty, maintenance and care instructions. If lost, obtain new from manufacturer at time of close-out.

END OF SECTION 114000

SECTION 129300 - SITE FURNISHINGS

1.1 General

A. Submittals

1. Manufacturer's literature: Submit manufacturer's published literature including specifications and installation instructions.

1.2 Products

A. Litter Receptacle: Poe, 34 gallon with standard opening, Manufactured by Landscape forms, Inc., or approved substitution. Color: silver

B. Recycle Receptacle: Poe, 34 gallon with 5” hole opening with recycle graphics, Manufactured by Landscape forms, Inc., or approved substitution. Color: silver

C. Bicycle Rack: Coil, Manufactured by Landscape forms, Inc., or approved substitution. Color: Black

D. Bench: Melville with seat divider Manufactured by Landscape forms, Inc. or approved substitution. Color: silver

1.3 Execution

A. Installation: Surface mount.

B. Provide all required liners and accessories as available.

END OF SECTION 129300

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
2. Interior Partitions:

END OF SECTION 210517

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: aluminum, 0.032 inch (0.8 mm) or anodized aluminum, 0.032 inch (0.8 mm)] thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Red.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

D. Pipe-Label Colors:

1. Background Color: Red.
2. Letter Color: White.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Aluminum, 0.032 inch (0.8 mm) or anodized aluminum, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping Color-Coding: Painting of piping is specified in Division 09 Section "High-Performance Coatings."

F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 2 inches (50 mm), square.
b. Wet-Pipe Sprinkler System: 1-1/2 inches (38 mm) square.

END OF SECTION 210553

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through wall into the building.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

C. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
2. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Construction Manager and Authority Having Jurisdiction no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's and Authority Having Jurisdiction written permission.

1.7 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.

B. PVC Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

2.2 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cascade Waterworks Manufacturing.
   b. Dresser, Inc.; Dresser Piping Specialties.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
   d. JCM Industries.
   e. ROMAC Industries Inc.
   f. Smith-Blair, Inc.; a Sensus company.
   g. Viking Johnson.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Manufacturer's standard.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 200 psig (1380 kPa) minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

2.3 GATE VALVES

A. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.
   b. Watts Water Technologies, Inc.

2. 175-psig (1200-kPa), UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:

   a. Description: Iron body and bonnet and bronze seating material.
   b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
   c. Pressure Rating: 175 psig (1200 kPa) minimum.
   d. End Connections: Flanged or grooved.

2.4 DETECTOR CHECK VALVES

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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

C. Standards: UL 312 and "Approval Guide," published by FM Global, listing.

D. Pressure Rating: 175 psig (1200 kPa).

E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.5 FIRE-DEPARTMENT CONNECTIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   1. Fire-End & Croker Corporation.
   2. Guardian Fire Equipment, Inc.
   3. Potter Roemer.

B. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire-department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.

C. Standard: UL 405.

D. Connections: Two NPS 2-1/2 (DN 65) inlets and one NPS 4 (DN 100) outlet.

E. Inlet Alignment: Inline, horizontal Square.

F. Finish Including Sleeve: Rough chrome plated.

G. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."

2.6 ALARM DEVICES

A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig (1725-kPa) working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company's standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

G. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches (910 mm) of cover over top.
2. Under Railroad Tracks: With at least 48 inches (1220 mm) of cover over top.
3. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) of additional cover.

H. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

I. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

1. Terminate fire-suppression water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

K. Comply with requirements in Division 21 Sections for fire-suppression-water piping inside the building.

L. Comply with requirements in Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 (DN 50) and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

J. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139.

K. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.

L. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

M. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

A. UL-Listed or FM-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

B. MSS Valves: Install as component of connected piping system.

3.6 DETECTOR CHECK VALVE INSTALLATION

A. Install in vault or aboveground.

B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire-department connection to mains.

B. Install protective pipe bollards on two sides of each fire-department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

3.8 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Supervisory Switches: Supervise valves in open position.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.
2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.9 CONNECTIONS

A. Connect fire-suppression water-service piping to existing water main. Use tapping sleeve and tapping valve.

B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.10 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.12 CLEANING

A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging[and disinfecting] activities.

3.13 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be the following:

1. PVC, Class 200 pipe listed for fire-protection service; PVC fittings of same class as pipe; and gasketed joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

B. Underground fire-suppression water-service shutoff valves NPS 2 (DN 50) and smaller shall be corporation valves or curb valves with ends compatible with piping.

C. Meter box fire-suppression water-service shutoff valves NPS 2 (DN 50) and smaller shall be meter valves.

D. Underground fire-suppression water-service shutoff valves NPS 3 (DN 80) and larger shall be the following:

1. 250-psig (1725-kPa), AWWA, iron, nonrising-stem, resilient-seated gate valves.

E. Fire-suppression water-service check valves NPS 3 (DN 80) and larger shall be the following:

1. UL-listed or FM-approved detector check valves.

END OF SECTION 211100

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Fire-department connections.
5. Alarm devices.
6. Pressure gages.

B. Related Sections:

1. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
2. Division 28 Section "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:

    a. Date: To be performed by Fire Sprinkler Contractor
    b. Time: To be determined.
    c. Performed by: Authority Having Jurisdiction.
    d. Location of Residual Fire Hydrant R: To be determined.
    e. Location of Flow Fire Hydrant F: To be determined.
    f. Static Pressure at Residual Fire Hydrant R: To be determined.
    g. Measured Flow at Flow Fire Hydrant F: To be determined.
    h. Residual Pressure at Residual Fire Hydrant R: To be determined.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.

    1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Fire-hydrant flow test report.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

    1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

        a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

1.9 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:

1. Notify Construction Manager and Authority Having Jurisdiction no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
2. Do not proceed with interruption of fire-suppression standpipe service without Construction Manager's and Authority Having Jurisdiction written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

B. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

C. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Pressure Rating: 250 psig (1725 kPa) minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or [ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig (1725 kPa).

B. Bronze OS&Y Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. NIBCO INC.
   b. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire-End & Croker Corporation.
   b. Potter Roemer.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2.6 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Fire-End & Croker Corporation.
   b. Potter Roemer.

2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Rough brass or bronze.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Yard-Type, Fire-Department Connection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Fire-End & Croker Corporation.
   b. Guardian Fire Equipment, Inc.

2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 300 psig (2070 kPa).
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Two.
11. Sleeve: Brass.
12. Sleeve Height: 18 inches (460 mm).
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish[, Including Sleeve]: Rough brass or bronze.
15. Outlet Size: NPS 4 (DN 100).

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.9 PRESSURE GAGES

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. Ashcroft Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.4 WATER-SUPPLY CONNECTIONS

A. Connect fire-suppression standpipe piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.5 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install drain valves on standpipes. Extend drain piping to outside of building.

E. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

F. Install alarm devices in piping systems.

G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

H. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

I. Fill wet-type standpipe system piping with water.

3.6 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3.8 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 (DN 40) hose-connection valves with flow-restricting device.

D. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.

E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets."

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete."

1. Install two protective pipe bollards on sides of each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Standard-pressure, wet-type, fire-suppression standpipe piping, [NPS 4 (DN 100) and smaller, shall be the following:

1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.

1.3 DEFINITIONS

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig (1200 kPa), but not higher than 250 psig (1725 kPa).

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. High-Pressure Piping System Component: Listed for 250-psig (1725-kPa) minimum working pressure.

C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

   a. Automobile Parking Areas: Ordinary Hazard, Group 1.
   b. Building Service Areas: Ordinary Hazard, Group 1.
   c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   d. Machine Shops: Ordinary Hazard, Group 2.
   e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   f. Office and Public Areas: Light Hazard.
   g. Residential Living Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:

   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.

4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:

   a. Residential Areas: 400 sq. ft. (37 sq. m).
   b. Office Spaces: 225 sq. ft. (20.9 sq. m).
   c. Storage Areas: 130 sq. ft. (12.1 sq. m).
   d. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
   e. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
   f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

   a. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

B. Fire-hydrant flow test report.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.9 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager and Authority Having Jurisdiction no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's and Authority Having Jurisdiction written permission.

1.10 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 30, Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Malleable- or Ductile-Iron Unions: UL 860.

E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

2.5 SPRINKLERS

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. Tyco Fire & Building Products LP.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

E. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft

metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:

1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright Pendent and Sidewall Sprinklers: wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

B.

1. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61[and NSF 372].

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Hand lever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of non-thermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. One-Piece, Bronze Ball Valves with Bronze Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. NIBCO INC.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. One-Piece, Bronze Ball Valves with Stainless-Steel Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. NIBCO INC.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, bronze ball valve with bronze or stainless-steel trim.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61[and NSF 372].

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 check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61and NSF 372 for valve materials for potable-water service.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Valves.
e. Hammond Valve.
f. Kitz Corporation.
g. The Macomb Groups.
h. Milwaukee Valve Company.
i. NIBCO INC.

j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Valves.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. <Insert manufacturer's name>.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by the following::

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Valves.
e. Kitz Corporation.
f. The Macomb Groups.
g. Milwaukee Valve Company.

h. NIBCO INC.
i. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: PTFE.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered.

2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or threaded.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged.
7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves, Class 125, bronze disc with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves, Class 125, bronze nonmetallic disc with soldered or threaded end connections.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves, Class 125, bronze disc with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves, Class 125, bronze nonmetallic disc with soldered or threaded end connections.

3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered or threaded end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.
4. Pipe stands.
5. Pipe positioning systems.
6. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use [mechanical-expansion anchors] instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe labels.

1.3 ACTION SUBMITTALS

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

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [partially cover] [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches ((38 mm) high).

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in [Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of [50 feet (15 m)] <Insert dimension> along each run. Reduce intervals to [25 feet (7.6 m)] <Insert dimension> in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Compressed-Air Piping:

   a. Background Color: Blue.
   b. Letter Color: White.

2. Domestic Cold Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Domestic Hot water Piping:

   a. Background Color: Yellow
   b. Letter Color: Black

4. Domestic Hot Water Return Piping:

   a. Background Color: Yellow
   b. Letter Color: Black

5. Glycol Loop Piping (Solar Water Heating)

   a. Background Color: Yellow
   b. Letter Color: Black

6. Natural Gas Piping:

   a. Background Color: Brown
   b. Letter Color: White

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Domestic recirculating hot-water piping.
3. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
d. <Insert manufacturer's name; product name or designation>.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

a. Engineered Brass Company.
b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. All insulation applications will be considered defective work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch, 3/4 inch, 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.
b. Flexible Elastomeric: 2 inches (50 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Flexible Elastomeric: 2 inches thick.

END OF SECTION 220719

SECTION 220800 – PLUMBING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes Division 15 responsibilities in the commissioning process.

1.3 COMMISSIONING AGENCY

A. The commissioning agency (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. Commissioning involves all parties to the design and construction process, including the mechanical Division 15 contractor, and all specialty sub-contractors within Division 15.

1.4 CONTRACTOR RESPONSIBILITY

A. The mechanical Division 15 contractor's responsibilities are defined in Section 230800 of the specifications. These responsibilities apply to all specialty sub-contractors and major equipment suppliers within Division 15. Each contractor and supplier shall review Section 230800.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMISSIONED SYSTEMS

A. A list of systems to be commissioned on this job shall include but not be limited to the following.
   1. Domestic Hot Water System
   2. Domestic Hot Water System controls
   3. Systems commissioned under 15995 and 16995

END OF SECTION 220800

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for domestic water service and fire suppression service mains.

B. The existing on-site water mains are a privately owned and maintained system; upstream of a metering system that separates the public system from the private system.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies that may be required and indicate dimensions, method of field assembly, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction or as designated on the plans for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others. Provide alternate temporary/ permanent water-distribution service prior to isolating any portion of the existing water that is intended to be decommissioned (removed or abandoned in place).

1.7 COORDINATION

A. Coordinate connection to water main with engineering company responsible to monitor this construction.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.2 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:

   a. American AVK Co.; Valves & Fittings Div.
   b. American Cast Iron Pipe Co.; American Flow Control Div.
   c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. East Jordan Iron Works, Inc.
   f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   g. McWane, Inc.; Kennedy Valve Div.
   h. McWane, Inc.; M & H Valve Company Div.
   i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
   j. Mueller Co.; Water Products Div.
   k. NIBCO INC.
   l. U.S. Pipe and Foundry Company.

4. Nonrising-Stem, Resilient-Seated Gate Valves:

   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig.
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

5. OS&Y, Rising-Stem, Resilient-Seated Gate Valves (if applicable):

   a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig.
      3) End Connections: Flanged.

B. Bronze Gate Valves (if applicable):

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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Red-White Valve Corporation.

4. Nonrising-Stem Gate Valves:

   a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron hand wheel.

      1) Standard: MSS SP-80.

2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:

   a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
   b. East Jordan Iron Works, Inc.
   c. Flowserve.
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
   e. McWane, Inc.; Kennedy Valve Div.
   f. McWane, Inc.; M & H Valve Company Div.
   g. Mueller Co.; Water Products Div.
   h. U.S. Pipe and Foundry Company.

4. Description: Sleeve and valve compatible with drilling machine.

   a. Standard: MSS SP-60.
   b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
   c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts (if applicable): UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.5 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

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. Ames Fire & Waterworks; a division of Watts Regulator Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Water Technologies, Inc.
   f. Wilkins; a Zurn company.

4. Standard: AWWA C511.
5. Operation: Continuous-pressure applications.
6. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
7. Size: Match to service pipe size.
8. Design Flow Rate: As defined on Mechanical Engineering plans.
9. Pressure Loss at Design Flow Rate: 8 psig maximum for NPS 2 and smaller; 12 psig for NPS 3 and larger.
10. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 3 and larger.
11. End Connections: Threaded for NPS 2 and smaller; mechanical joint for NPS 3 and larger.
12. Configuration: Designed for straight through, horizontal center section, and vertical outlet flow.
13. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 3 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:

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. Ames Fire & Waterworks; a division of Watts Regulator Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Watts Water Technologies, Inc.
    f. Wilkins; a Zurn company.

4. Standard: AWWA C510.
5. Operation: Continuous-pressure applications, unless otherwise indicated.
6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
7. Size: Match service line size.
8. Design Flow Rate: As defined on Mechanical Engineering plans.
9. Pressure Loss at Design Flow Rate: 3 psig for NPS 2 and smaller; 5 psig for NPS 3 and larger.
10. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 3 and larger.
11. End Connections: Threaded for NPS 2 and smaller; mechanical joint for NPS 3 and larger.
12. Configuration: Designed for horizontal, straight through flow.
13. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 3 and larger.

2.6 CONCRETE VAULTS (IF APPLICABLE)

A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.

1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

    a. Dimension: 24-inch minimum diameter, unless otherwise indicated.

3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.

    a. Dimension: 24-inch minimum diameter, unless otherwise indicated.

4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.7 FIRE HYDRANTS

A. Wet-Barrel Fire Hydrants:

1. Available Manufacturers: Subject to compliance with local fire department requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:

    a. American AVK Co.; Valves & Fittings Div.
    b. Jones, James Company.
    c. McWane, Inc.; Clow Valve Co. Div. (Corona).
    d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    e. Mueller Co.; Water Products Div.

4. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550.

    a. Standard: AWWA C503.
    b. Pressure Rating: 150 psig minimum.
    c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department.
    d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
    e. Direction of Opening: Open hydrant valves by turning nut to left or counterclockwise.
    f. Exterior Finish: As defined in the plan details or directed by Fire Marshall.

2.8 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

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 local fire department requirements, provide the product indicated on drawings or a comparable product by one of the following:

    a. Elkhart Brass Mfg. Co., Inc.
    b. Fire End & Croker Corporation.
    c. Guardian Fire Equipment, Inc.
    d. Kidde Fire Fighting.
    e. Potter Roemer.
    f. Reliable Automatic Sprinkler Co., Inc.

4. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch high brass sleeve; and round escutcheon plate.

    a. Standard: UL 405.
    b. Connections: Two NPS 2-1/2 inlets or as required by local fire department.
    c. Inlet Alignment: As defined on the plans.
    d. Finish Including Sleeve: Polished chrome-plated.
    e. Escutcheon Plate Marking: “AUTO SPKR & STANDPIPE."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

3.3 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections larger than NPS 2 with tapping machine according to the following:

    1. Install tapping sleeve and tapping valve according to MSS SP-60.
    2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
    3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.

4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

D. Make connections NPS 2 (if applicable) and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

E. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

G. Install PE pipe (if applicable) according to ASTM D 2774 and ASTM F 645.

H. Bury piping with depth of cover over top at least 30 inches**.**

I. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, tie-rods and clamps, and other supports.

3.4 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
4. PE Piping Insert-Fitting Joints (if applicable): Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
5. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
   1. Locking mechanical joints.
   2. Set-screw mechanical retainer glands.
   3. Bolted flanged joints.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
   2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
   3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices if manufacturer specifies same.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

3.7 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.8 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA Fire Hydrants: Comply with AWWA M17.

D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.9 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install protective pipe bollards on two sides of each fire department connection where the plans require same.

3.10 CONNECTIONS

A. Connect water-distribution piping to existing water main. Use tapping sleeve and valve.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 2 hours. After surging all the trapped air from the line call for a formal hydrostatic test of the system with the engineer. The full procedure for this test and the maximum allowable leakage is defined in the plans. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.12 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.13 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction or a private laboratory for testing. Two consecutive days of successful testing is required. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

F. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Elkhart Products Corporation.
   b. NIBCO Inc.
   c. Viega.

2. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

G. Copper Push-on-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

   a. Victaulic Company.

2. Description:

   a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
   b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

E. Install domestic water piping level without pitch and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping to permit valve servicing.

L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

P. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer than 100 Feet (30 m) if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

F. Install supports for vertical copper tubing every 10 feet (3 m).

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.7 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.9 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller shall be the following:

1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed or copper pressure-seal-joint fittings; and pressure-sealed joints.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper push-on-joint fittings; and push-on joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Outlet boxes.
5. Hose bibbs.
6. Water-hammer arresters.
7. Trap-seal primer valves.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 224723 "Remote Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Basis-of-Design Product: Subject to compliance with requirements, product by one of the following:

a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. FEBCO; a division of Watts Water Technologies, Inc.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Subject to compliance with requirements, provide product by one of the following:

a. Arrowhead Brass Products.
b. Cash Acme; a division of Reliance Worldwide Corporation.
c. Conbraco Industries, Inc.
d. Legend Valve.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated or rough bronze.

C. Pressure Vacuum Breakers:

1. Subject to compliance with requirements, provide product by one of the following:

a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

a. Armstrong International, Inc.
b. ITT Corporation; Bell & Gossett Div.
c. NIBCO Inc.
d. TACO Incorporated.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves >:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO Inc.
h. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings:

a. Leonard Valve Company.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
4. Type: Exposed-mounted, copper encapsulated thermostatic assembly water mixing valve with Teflon shuttle, lead free.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F (deg C)>.

2.6 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

a. Oatey.
b. Symmons Industries, Inc.
c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
d. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.

2. Mounting: Recessed.

3. Material and Finish: Plastic box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 (DN 15) gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
6. Drain: NPS 2 (DN 50) standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- (1500-mm-) long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- (1200-mm-) long, rubber household clothes washer drain hose with hooked end.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 (DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle or operating key.
13. Operation for Finished Rooms: Wheel handle or operating key.
14. Include operating key with each operating-key hose bibb.
15. Include or integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Precision Plumbing Products, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.9 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. MIFAB, Inc.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on drawings or comparable product by one of the following:

   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
3. Size: NPS 1-1/4 (DN 32) minimum.
4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

B. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

F. Install water-hammer arresters in water piping according to PDI-WH 201.

G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Calibrated balancing valves.
3. Primary, thermostatic, water mixing valves.
4. Primary water tempering valves.
5. Outlet boxes.
6. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure couplings.
3. Cleanouts.
4. Manholes.

1.2 ACTION SUBMITTALS

A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

C. Field quality-control reports.

PART 2 - PRODUCTS

A. Heavy-Duty, Shielded Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. Stant; a Tompkins company.
f. Tyler Pipe.

3. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.2 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Concrete Pipes: ASTM C 443, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Heavy Duty.
2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 8-inch minimum thickness for floor slab and 8-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 8-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch minimum-width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.6 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, sanitary sewer piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope, as indicated in the plans, unless otherwise indicated.
2. Install piping NPS 6 (for service pipe) and larger NPS 8 (for main pipe between manholes) with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors as needed.
3. Install piping with 36-inch minimum cover.
4. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
2. Join dissimilar pipe materials with non-pressure-type, flexible or rigid couplings.

B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Form continuous concrete channels and benches between inlets and outlet.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

F. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service and hard surface walk areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 12 by 12 inches by 6 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping.

2. Make branch connections from side into existing piping, NPS 8 to NPS 6. Remove section of existing pipe, install wye fitting into existing piping.

3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease, oil and sand interceptors.

3.8 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.9 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of engineer and authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

C. Infiltration and excessive pipe deflection constitute defects that must be repaired.

D. Replace defective piping using new materials, and repeat testing until piping is within allowances specified.

3.10 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

   a. ANACO-Husky.
   b. Dallas Specialty & Mfg. Co.
   c. Fernco Inc.
   d. Matco-Norca, Inc.
   e. MIFAB, Inc.
   f. Mission Rubber Company; a division of MCP Industries, Inc.
   g. Stant.
   h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Non-pressure Transition Couplings:

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) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company; a division of MCP Industries, Inc.
4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Non-pressure Transition Couplings:

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) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

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) Cascade Waterworks Mfg. Co.
2) Dresser, Inc.
3) EBAA Iron, Inc.
4) JCM Industries, Inc.
5) Romac Industries, Inc.
6) Smith-Blair, Inc.; a Sensus company.
7) The Ford Meter Box Company, Inc.
8) Viking Johnson.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard or carbon steel or stainless steel ductile iron or malleable iron.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    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) Capitol Manufacturing Company.
        2) Central Plastics Company.
        3) Hart Industries International, Inc.
        4) Jomar International Ltd.
        5) Matco-Norca, Inc.
        6) McDonald, A. Y. Mfg. Co.
        7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
        8) Wilkins; a Zurn company.

    b. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 250 psig (1725 kPa).
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    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) Capitol Manufacturing Company.
        2) Central Plastics Company.
        3) Matco-Norca, Inc.
        4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
        5) Wilkins; a Zurn company.

    b. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C) 150 psig (1035 kPa) 175 psig (1200 kPa) 300 psig (2070 kPa).
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Description:

1) Non-conducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig (1035 kPa).
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

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) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. 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."

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground PVC piping according to ASTM D 2321.

R. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

S. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

G. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, non-pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges or flange kits or nipples.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping, Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[, valve,] and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

K. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

L. Install supports for vertical PVC piping every 48 inches (1200 mm).

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
6. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed [PVC] Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; CISPI hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded or shielded, non-pressure transition couplings.

C. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded or shielded, non-pressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded or shielded, non-pressure transition couplings.

E. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; coupled joints.
2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded or shielded, non-pressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Trench drains.
4. Air-admittance valves.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Oil interceptors.

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 224300 "Medical Plumbing Fixtures" for plaster sink interceptors.
3. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Oil interceptors.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in "Miscellaneous Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1) Josam Company.
2) MIFAB, Inc.
3) Smith, Jay R. Mfg. Co.
4) Tyler Pipe.
5) Watts Drainage Products.
6) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Drilled and threaded brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

      1) Josam Company.
      2) Oatey.
      3) Sioux Chief Manufacturing Co., Inc.
      4) Smith, Jay R. Mfg. Co.
      5) Tyler Pipe.
      6) Watts Drainage Products.
      7) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron or Stainless steel.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads, set-screws, or other device].
10. Frame and Cover Material and Finish: Copper alloy, polished bronze, rough bronze, or stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra Heavy, heavy, light, or medium duty.
13. Riser: ASTM A 74, extra heavy or service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Drilled-and-threaded, brass, or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. Commercial Enameling Co.
   b. Josam Company; Josam Div.
   c. MIFAB, Inc.
   d. Prier Products, Inc.
   e. Smith, Jay R. Mfg. Co.
   f. Tyler Pipe; Wade Div.
   g. Watts Drainage Products.
   h. Zurn Plumbing Products Group; Light Commercial Operation, Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Outlet: Bottom.
6. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
7. Top or Strainer Material: Nickel bronze or stainless steel.
8. Top of Body and Strainer Finish: Polished nickel bronze or stainless steel.
9. Top Shape: Round or square.
10. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
11. Trap Material: Cast iron or copper.
12. Trap Pattern: Deep-seal P-trap or standard P-trap.
13. Trap Features: Trap-seal primer valve drain connection.

B. Stainless-Steel Floor Drains:

1. ASME A112.3.1, Stainless-Steel Floor Drains:

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

      1) Josam Company.
      2) MIFAB, Inc.
      3) Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.3.1 or ASME A112.6.3.
3. Outlet: Bottom.
4. Top or Strainer Material: Stainless steel.
5. Top Shape: Round or square.
6. Trap-Primer Connection: Required.

7. Trap Material: Cast iron.
8. Trap Pattern: Deep-seal P-trap or standard P-trap.

2.3 TRENCH DRAINS

A. Trench Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.

2.4 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Studor, Inc.
   b. Durgo, Inc.
   c. Oatey.
   d. ProSet Systems Inc.
   e. RectorSeal.
   f. Ayrlett, LLC.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.5 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.

b. Thaler Metal Industries Ltd.

2. Description: Manufactured assembly made of [4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

   a. Open-Top Vent Cap: Without cap.
   b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
   c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
   b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch (25 mm) or 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.8 OIL INTERCEPTORS

A. Oil Interceptors:

1. Cast-Iron or Steel Oil Interceptors:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1) Highland Tank & Mfg. Co.
2) Josam Company.
3) MIFAB, Inc.
4) Rockford Sanitary Systems, Inc.
5) Applied Chemical Technology, Incorporated.
6) Smith, Jay R. Mfg. Co.
7) Tyler Pipe.

8) Watts Drainage Products.
9) Zurn Plumbing Products Group.
10) Oldcastle Pre-cast

2. Plastic Oil Interceptors:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1) Ashland Trap Distribution Co.
2) Highland Tank & Mfg. Co.
3) Town & Country Plastics, Inc.
4) Schier Products.

3. Type: Factory-fabricated interceptor for separating and removing light oil from wastewater.
4. Body Material: Cast iron, steel, or plastic.
5. Interior Lining: Corrosion-resistant enamel.
6. Exterior Coating: Corrosion-resistant enamel.
7. Inlet and Outlet Size: 6 inches.
8. Cleanout: Integral or field installed on outlet.
9. Mounting: Underground.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

F. Install fixture air-admittance valves on fixture drain piping.

G. Install stack air-admittance valves at top of stack vent and vent stack piping.

H. Install air-admittance-valve wall boxes recessed in wall.

I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

K. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

L. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.

M. Install deep-seal traps on floor drains and other waste outlets, if indicated.

N. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

O. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

P. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

Q. Install vent caps on each vent pipe passing through roof.

R. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

S. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Section 231113 "Facility Fuel-Oil Piping."

T. Install wood-blocking reinforcement for wall-mounting-type specialties.

U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

B. Set flashing on floors and roofs in solid coating of bituminous cement.

C. Secure flashing into sleeve and specialty clamping ring or device.

D. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Oil interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

B. Related Sections:

1. Section 221429 "Sump Pumps" for storm drainage pumps.
2. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.

C. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy fittings or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 2 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Install engineered siphonic drain specialties and storm drainage piping in locations indicated.

Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

C. Plastic, Non-pressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting[, valve,] and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

J. Install supports for vertical PVC piping every 48 inches (1200 mm).

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Cleanouts.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings:

a. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-inch (357-mm) diameter. Required.
5. Dome Material: Cast iron or Stainless steel.
6. Water Dam: Required for secondary roof drains 4 inches (51 mm) high.

2.2 CLEANOUTS

A. Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Plumbing Products Group; Light Commercial Products Operation.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for threaded, adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule Material: Cast iron or Stainless steel.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket or brass plug with tapered threads or cast-iron plug.
9. Adjustable Housing Material: Cast iron or plastic with threads, set-screws, or other device].

B. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on drawings or comparable product by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps.

B. Related Section:

1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Liberty Pumps.

b. Stancor Pumps.

2. Description: Factory-assembled and -tested sump-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, design for clear wastewater handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

9. Controls:

a. Enclosure: NEMA 250, Type 1.
b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
c. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
d. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

10. Control-Interface Features:

a. Remote Alarm Contacts: For remote alarm interface.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform Startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

END OF SECTION 221429

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig (1380 kPa) or less.

B. Related Sections include the following:

1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig (1035 and 1380 kPa).

B. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig (1035 kPa) or less.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Flexible pipe connectors.
2. Quick couplings.

1.5 QUALITY ASSURANCE

A. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
5. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.3 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.4 FLEXIBLE PIPE CONNECTORS

A. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 250 psig (1725 kPa) minimum.
2. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 250 psig (1725 kPa) minimum.
2. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.5 QUICK COUPLINGS

A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Straight-through type with barbed outlet for attaching hose.

C. Valve-less Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

B. High-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

3.2 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," according to the following:

1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
2. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
3. Equipment Isolation NPS 2 (DN 50) and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

B. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed[or soldered] joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

M. Install piping to permit valve servicing.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.7 CONNECTIONS

A. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or 42 clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within [12 inches (300 mm)] <Insert dimension> of each fitting and coupling.

G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

H. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.
4. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.

I. Install supports for vertical, Schedule 40, steel piping every 15 feet (4.6 m).

3.9 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

END OF SECTION 15211

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, 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.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Finned-Tube, Gas-Fired, Domestic-Water Heaters:

1) Heat Exchanger: Five years.
2) Controls and Other Components: One year.
3) Separate Hot-Water Storage Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Lochinvar Corporation.

2. Standard: ANSI Z21.10.3/CSA 4.3.

3. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.

   a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

      1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

4. Factory-Installed Storage-Tank Appurtenances:

   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   e. Jacket: Steel with enameled finish.
   f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
   g. Temperature Control: Adjustable thermostat.
   h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

   1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."

D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Fill domestic-water heaters with water.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."

C. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."

D. Drawings indicate general arrangement of piping, fittings, and specialties.

E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, domestic-water heaters.

END OF SECTION 223400

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.

c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard and Handicapped, complying with ICC/ANSI A117.1.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. (4.8 L) per flush.
h. Spud Size and Location: NPS 1-1/2 (DN 40); top.
i. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sloan Valve Company.

b. American Standard America.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Consumption: 1.28 gal. (4.8 L) per flush.
10. Minimum Inlet: NPS 1 (DN 25).
11. Minimum Outlet: NPS 1-1/4 (DN 32).

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Olsonite Seat Co.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim, open front.
6. Seat Cover: Not required.
7. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

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. Urinals.
2. Flushometer valves.

B. Related Requirements:

1. Section 224600 "Security Plumbing Fixtures" for security urinals.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Wall hung, bottom outlet, washout.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.

c. Drain: Separate removable chrome-plated dome strainer with chrome-plated, NPS 1-1/2 (DN 40) tailpiece.
d. Strainer or Trapway: Manufacturer's standard strainer and NPS 1-1/2 (DN 40) tailpiece.
e. Design Consumption: Low.
f. Inlet Spud Size and Location: NPS 3/4 (DN 20); top.
g. Outlet Size and Location: NPS 1-1/2 (DN 40); bottom.
h. Color: White.

3. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap:

1) Size: NPS 1-1/2 (DN 50).
2) Material: Chrome-plated, and chrome-plated brass or steel wall flange.
3) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-(0.30-mm-) thick stainless-steel tube to wall; and stainless-steel wall flange.

4. Support: ASME A112.6.1M, Type II, urinal carrier with hanger and bearing plates. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sloan Valve Company.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Consumption: 0.5 gal. (1.9 L) per flush.
10. Minimum Inlet: NPS 3/4 (DN 20).
11. Minimum Outlet: NPS 1-1/4 (DN 32)].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use carriers without waste fitting for urinals with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Lavatories.
2. Faucets.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential lavatories.
2. Section 224300 "Medical Plumbing Fixtures" for healthcare lavatories.
3. Section 224600 "Security Plumbing Fixtures" for security lavatories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory: Oval, self-rimming, vitreous china, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Self-rimming for above-counter mounting.
c. Nominal Size: Oval, 20 by 17 inches (508 by 432 mm).
d. Nominal Size: Round, 19 inches (483 mm)
e. Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers, 4-inch (102-mm) centers.
f. Faucet-Hole Location: Top.
g. Color: White.
h. Mounting Material: Sealant.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm).
d. Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.

B. Lavatory: Wheelchair, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Slab or wheelchair.
c. Nominal Size: Rectangular, 27 by 20 inches (686 by 508 mm).
d. Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting: For concealed-arm carrier.

3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

2.3 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm (1.5 L/min.).
8. Mounting Type: Deck, exposed.
9. Valve Handle(s): Single lever.
10. Spout: Rigid type.
11. Spout Outlet: Aerator laminar flow spray.
12. Operation: Non-compression, manual.
13. Drain: Not part of faucet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Service sinks.
2. Handwash sinks.
3. Sink faucets.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks: Enameled, cast iron, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. American Standard America.
b. Kohler Co.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:

a. Standard: ASME A112.19.1/CSA B45.2.
b. Style: With front apron and raised back.
c. Nominal Size: 28 by 28 inches (710 by 710 mm).
d. Color: White.
e. Drain: Grid with [NPS 2 (DN 50)] [NPS 3 (DN 80)] outlet.
f. Rim Guard: Coated wire.

2.2 HANDWASH SINKS

A. Handwash Sinks: Stainless steel, wall mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Elkay Manufacturing Co.

2. Fixture:

a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
b. Type: Basin with radius corners, back for faucet, and support brackets.
c. Nominal Size: 17 by 16 by 5 inches (432 by 406 by 127 mm).

3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
4. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
5. Support: ASME A112.6.1M, Type II, sink carrier.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, single-control mixing valve.

1. Commercial, Solid-Brass Faucets.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Elkay Manufacturing Co.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: [Commercial, solid brass].
6. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
7. Handle(s): Lever.

8. Mounting Type: Deck, exposed.
9. Spout Outlet: Spray.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223 - COMMERCIAL SHOWERS

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. Individual shower receptors.
2. Shower faucets.

B. Related Requirements:

1. Section 224500 "Emergency Plumbing Fixtures" for emergency showers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Symmons.

2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
3. Faucet:

   a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
   b. Body Material: Solid brass.
   c. Finish: Polished chrome plate.
   d. Maximum Flow Rate: 1.5 gpm (9.5 L/min.) unless otherwise indicated.
   e. Mounting: Exposed.
   f. Operation: Single-handle, twist or rotate control.
   g. Antiscald Device: Integral with mixing valve.
   h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

4. Supply Connections: NPS 1/2 (DN 15).
5. Shower Head:

   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Shower Head Material: Metallic with chrome-plated finish.
   c. Spray Pattern: Adjustable.
   d. Integral Volume Control: Required.
   e. Shower-Arm, Flow-Control Fitting: 1.5 gpm (5.7 L/min.).
   f. Temperature Indicator: Integral with faucet.

C. Shower Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings Symmons or comparable product by one of the following:

   a. Leonard Valve Company.
   b. Powers; a division of Watts Water Technologies, Inc.

2. Description: Single-handle, thermostatic mixing valve with hot- and cold-water indicators; check stops; and shower head.
3. Faucet:

a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 1.5 gpm (9.5 L/min.) unless otherwise indicated.
e. Mounting: Exposed.
f. Operation: Single-handle, twist or rotate control.
g. Antiscald Device: Integral with mixing valve.
h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

4. Supply Connections: NPS 1/2 (DN 15).
5. Shower Head:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Shower Head Material: Metallic with chrome-plated finish.
c. Spray Pattern: Adjustable.
d. Integral Volume Control: Required.
e. Shower-Arm, Flow-Control Fitting: 1.5 gpm (5.7 L/min.).
f. Temperature Indicator: Integral with faucet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball, valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Set shower receptors in leveling bed of cement grout.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION 224223

SECTION 224713 - DRINKING FOUNTAINS

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 drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains: Stainless steel, wall mounted.

1. Stainless-Steel Drinking Fountains:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:

1) Elkay Manufacturing.

2. Standards:

a. Comply with ASME A112.19.3/CSA B45.4.
b. Comply with NSF 61.

3. Back Panel: Stainless-steel wall plate behind drinking fountain.
4. Bubblers: One, with adjustable stream regulator, located on deck.
5. Control: Push bar.
6. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
7. Supply: NPS 3/8 (DN 10) with shutoff valve.

8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) chrome-plated brass P-trap and waste.
9. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 224716 - PRESSURE WATER COOLERS

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 pressure water coolers and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Wall mounted, wheelchair accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Elkay Manufacturing Co.

2. Cabinet: Bi-level with two attached cabinets and with a bi-level skirt kit, all stainless steel.
3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
4. Control: Push bar.
5. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.
6. Supply: NPS 3/8 (DN 10) with shutoff valve.
7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

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.

10. Capacities and Characteristics:

a. Cooled Water: 5 gph (0.0053 L/s) or 8 gph (0.0084 L/s).
b. Ambient-Air Temperature: 90 deg F (32 deg C).
c. Inlet-Water Temperature: 80 deg F (27 deg C).
d. Cooled-Water Temperature: 50 deg F (10 deg C).
e. Electrical Characteristics:

1) Volts: 120-V ac.
2) Phase: Single.
3) Hertz: 60.

11. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal fittings.
3. Grout.

PART 2 - PRODUCTS

2.1 SLEEVES

A. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6: Sleeve-seal fittings.

2. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6: Sleeve-seal fittings.

3. Interior Partitions:

    a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

END OF SECTION 230518

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) "Metal Ducts” an "Nonmetal Ducts” for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.3 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

I. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections. Section "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Use carbon-steel pipe hangers and supports and attachments for general service applications.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

G. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage a TAB contractor.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Nonmetal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
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 of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.
4. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.

7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, 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.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).

h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches (mm), and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h (kW).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm (L/s).
i. Face area in sq. ft. (sq. m).
j. Minimum face velocity in fpm (m/s).

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).
b. Air flow rate in cfm (L/s).
c. Air velocity in fpm (m/s).
d. Entering-air temperature in deg F (deg C).
e. Leaving-air temperature in deg F (deg C).
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm (L/s).
    b. Entering-water temperature in deg F (deg C).
    c. Leaving-water temperature in deg F (deg C).
    d. Water pressure drop in feet of head or psig (kPa).
    e. Entering-air temperature in deg F (deg C).
    f. Leaving-air temperature in deg F (deg C).

M. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.12 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Verify that balancing devices are marked with final balance position.
    e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.

B. Related Sections:

1. Division 23 Section "HVAC Equipment Insulation."
2. Division 23 Section "HVAC Piping Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Duct Wrap.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Duct Wrap.
e. Manson Insulation Inc.; Alley Wrap.
f. Owens Corning; All-Service Duct Wrap.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
   c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

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) GEMCO.
2) Midwest Fasteners, Inc.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Factory-insulated flexible ducts.
3. Flexible connectors.
4. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

B. Concealed, rectangular, return-air duct insulation shall be one of the following.

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

C. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

END OF SECTION 230713

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Provide information requested by the CxA for final commissioning documentation.

C. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

1.8 INFORMATIONAL SUBMITTALS

A. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas, hot-water and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 AIR-HANDLING-UNIT CONTROL SEQUENCES

A. Start and Stop Supply Fan(s):

1. Enable: Freeze Protection:

a. Input Device: Duct-mounted averaging element thermostat, located before supply fan.
b. Output Device: Hard wired through motor starter; analog alarm panel.
c. Action: Allow start if duct temperature is above 37 deg F (3 deg C); signal alarm if fan fails to start as commanded.

2. Enable: High-Temperature Protection:

a. Input Device: Duct-mounted thermostat, located in return air.
b. Output Device: Hard wired through motor starter; analog alarm panel.
c. Action: Allow start if duct temperature is below 300 deg F (150 deg C).

3. Enable: Smoke Control:

a. Input Device: Duct-mounted smoke detector, located in supply air.
b. Output Device: Hard wired through motor starter; analog alarm panel.
c. Action: Allow start if duct is free of products of combustion.

4. Initiate: Occupied Time Schedule:

a. Input Device: Thermostat.
b. Output Device: Thermostat to motor starter.
c. Action: Energize fan(s).

5. Initiate: Unoccupied Time Schedule:

   a. Input Device: Room thermostat.
   b. Output Device: Room thermostat to motor starter.
   c. Action: Energize fan(s).

6. Unoccupied Ventilation:

   a. Input Device: Room thermostat.
   b. Output Device: Room thermostat to motor starter.
   c. Action: Cycle fan(s) during unoccupied periods.

7. Display: Supply-fan on-off indication.

B. Supply Fan(s) Variable-Volume Control:

1. Occupied Time Schedule:

   a. Input Device: Thermostat.
   b. Output Device: Binary output.
   c. Action: Enable control.

C. Coordination of Air-Handling Unit Sequences: Ensure that preheat, mixed-air, heating-coil, and cooling-coil controls have common inputs and do not overlap in function.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Strainers.
4. Pressure-regulating valves.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

A. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

C. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F (4.4 deg C).
6. Superheat: Nonadjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig (4820 kPa).

D. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

E. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

2.3 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Suction Lines NPS 3-1/2 (DN 90) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR L (B), drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

B. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

C. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

D. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

E. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
2. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
3. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
4. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Support multifloor vertical runs at least at each floor.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.

6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative 1-inch wg (250 Pa).
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 6.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 6.

C. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm (5 m/s) or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fibrous-glass ducts and fittings.
2. PVC ducts and fittings.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
2. Division 23 Section "Metal Ducts" for single- and double-wall, rectangular and round ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions to comply with ASCE/SEI 7.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Fibrous-glass duct materials.
2. PVC duct materials.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
4. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 FIBROUS-GLASS DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation; Insulation Group.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.

B. Fibrous-Glass Duct Materials: Resin-bonded fiberglass, faced on the outside surface with fire-resistive FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.

1. Duct Board: Factory molded into rectangular boards.
2. Round Duct: Factory molded into straight round duct and smooth fittings.
3. Temperature Limits: 40 to 250 deg F (5 to 121 deg C) inside ducts; 150 deg F (66 deg C) ambient temperature surrounding ducts.

4. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F (0.035 W/m x K) at 75 deg F (24 deg C) mean temperature.
5. Moisture Absorption: Not exceeding 5 percent by weight at 120 deg F (49 deg C) and 95 percent relative humidity for 96 hours when tested according to ASTM C 1104/C 1104M.
6. Permeability: 0.02 perms (1.15 ng/Pa x s x sq. m) maximum when tested according to ASTM E 96/E 96M, Procedure A.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
9. Required Markings: EI rating, UL label, and other markings required by UL 181 on each full sheet of duct board.

C. Closure Materials:

1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.

   a. Tape: Aluminum foil-scrim tape imprinted with listing information.
   b. Minimum Tape Width: 2-1/2 inches (64 mm); 3 inches (76 mm) for duct board thicker than 1 inch (25 mm).
   c. Staples: 1/2-inch (13-mm) outward clinching, 2 inches (51 mm) o.c. in tabs, one tab per joint.
   d. Water resistant.
   e. Mold and mildew resistant.

D. Fabrication:

1. Select joints, seams, transitions, elbows, and branch connections and fabricate according to SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 2, "Specifications and Closure," and Chapter 4, "Fittings and Connections."
2. Fabricate 90-degree mitered elbows to include turning vanes.
3. Reinforcements: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 5, "Reinforcement" for channel- and tie-rod reinforcement materials, spacing, and fabrication.
4. Preformed Round Duct: Comply with NAIMA AH116, "Fibrous Glass Duct Construction Standards," Section VII, "Preformed Round Duct."

2.2 PVC DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Plastics, Inc.
2. GPK Products, Inc.
3. Harvel Plastics, Inc.
4. Kroy Industries, Inc.
5. Northern Pipe Product Inc.; an Otter Tail company.
6. Plastinetics Inc.
7. Spears Manufacturing Company.

B. Duct and Fittings:

1. Round Duct: Comply with cell Classification 12454-B in ASTM D 1784, with external loading properties of ASTM D 2412.
2. Round Fittings: Socket end molded of same material, pressure class, and joining method as duct.
3. Rectangular Fittings: Minimum 0.125-inch- (3.2-mm-) thick flat sheet with heat-formed corners and continuous welded butt joints.

C. Joining Materials: PVC solvent cement complying with ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Chapter 3, "Standards of Construction for PVC Duct Systems."
2. Fabricate 90-degree rectangular mitered elbows to include turning vanes, 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

E. Drains: PVC drain pockets with a minimum of NPS 1 (DN 25) threaded PVC pipe connections.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables: ASTM A 603, galvanized steel with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts with fewest possible joints.

B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

D. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

E. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

F. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials.Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

G. Install fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards."

H. Install PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 6, "Hangers and Supports.".

B. Install hangers and supports for PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual," Chapter 3, "Standards of Construction for PVC Duct Systems."

C. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 PAINTING

A. Paint interior of PVC ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.4 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.5 DUCT SCHEDULE

A. Indoor Supply and Return Air Conditioning Ducts and Fittings:

1. Fibrous-Glass Round Ducts and Fittings:

a. Minimum Thickness: 1 inch (25 mm).

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Turning vanes.
5. Flexible ducts.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

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

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1 Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. METALAIRE, Inc.
f. Nailor Industries Inc.
g. Pottorff; a division of PCI Industries, Inc.
h. Ruskin Company.
i. Trox USA Inc.
j. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.

4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch (1.62 mm) thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

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. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.

9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat or Angle shaped.
2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches (200 mm).
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.

7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.
11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.5 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. [Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

2.6 FLEXIBLE DUCTS

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. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

C. Set dampers to fully open position before testing, adjusting, and balancing.

D. Install test holes at fan inlets and outlets and elsewhere as indicated.

E. Install fire dampers according to UL listing.

F. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

G. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

H. Connect diffusers or light troffer boots to ducts directly or with maximum 120-inch lengths of flexible duct clamped or strapped in place.

I. Connect flexible ducts to metal ducts with draw bands.

J. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

END OF SECTION 233300

SECTION 233416 - CENTRIFUGAL HVAC FANS

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: For each product.

1. Backward-inclined centrifugal fans.
2. Forward-curved centrifugal fans.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Dampers, including housings, linkages, and operators.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Unusual Service Conditions:

1. Ambient Temperature: 90 deg F.
2. Altitude: 0 feet (m) above sea level.
3. High humidity.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Spun inlet cone with flange.
4. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, Ll0 at 50,000 hours.
3. Roller-Bearing Rating Life: ABMA 11, Ll0 at 50,000 hours.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.3 FORWARD-CURVED CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Spun inlet cone with flange.
4. Outlet flange.

D. Forward-Curved Wheels:

1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Prelubricated and Sealed Shaft Bearings:

1. Self-aligning, pillow-block-type ball bearings.
2. Ball-Bearing Rating Life: ABMA 9, Ll0 at 50,000.
3. Roller-Bearing Rating Life: ABMA 11, Ll0 at 50,000.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting: Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of dehumidification unit.

1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction.

G. Install units with clearances for service and maintenance.

H. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct

connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

END OF SECTION 233416

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Hart & Cooley Inc.
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Titus.

e. Tuttle & Bailey.

2. Material: Steel or Aluminum as shown on drawings.
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches.
5. Face Style: Three cone.
6. Mounting: Surface or T-bar as shown on drawings.
7. Pattern: Adjustable.
8. Dampers: Radial opposed blade.

B. Louver Face Diffuser :

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. METALAIRE, Inc.
   b. Nailor Industries Inc.
   c. Titus.
   d. Tuttle & Bailey.

2. Material: Steel or Aluminum as shown on drawings.
3. Finish: Baked enamel, white.
4. Face Size: As shown on drawings.
5. Mounting: Surface or T-bar as shown on drawings.
6. Pattern: Adjustable core style.
7. Dampers: Radial opposed blade.
8. Accessories:

   a. Square to round neck adaptor.
   b. Adjustable pattern vanes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,

locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
2. Wind Loads: Determine loads based on a uniform pressure (corresponding to 190 mph winds) lbf/sq. ft. acting inward or outward.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1-2004.

1.4 ACTION SUBMITTALS

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

B. LEED Submittal:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.

B. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

C. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

C. Materials: Galvanized-steel sheet, minimum 0.064-inch- (1.62-mm-) thick base and 0.040-inch- (1.0-mm-) thick hood; suitably reinforced.

D. Bird Screening: Galvanized-steel, 1/2-inch- (12.7-mm-) square mesh, 0.041-inch (1.04-mm) wire.

E. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

F. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and an overall minimum dry film thickness of 2 mils (0.05 mm).

   a. Color and Gloss: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

END OF SECTION 233723

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

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 Type I commercial kitchen hoods.

1.3 DEFINITIONS

A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.

B. Standard Hood: A hood, usually field fabricated,that complies with design, construction, and performance criteria of applicable national and local codes.

C. Type I Hood: A hood designed for grease exhaust applications.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Standard hoods.
2. Filters/baffles.
3. Fire-suppression systems.
4. Lighting fixtures.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Shop Drawing Scale: 1/4 inch = 1 foot (1:50).
2. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
3. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
4. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
5. Show control cabinets.
6. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
7. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

8. Wiring Diagrams: Power, signal, and control wiring.
9. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.

PART 2 - PRODUCTS

2.1 HOOD MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Minimum Thickness: 0.050 inch (1.3 mm).
2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

   a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.

3. Concealed Stainless-Steel Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
4. Exposed Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished).
5. Exposed Surfaces: ASTM A 480/A 480M, No. 3 finish (intermediate polished surface).
6. Exposed Surfaces: ASTM A 480/A 480M, No. 4 finish (directional satin).
7. Exposed Surfaces: ASTM A 480/A 480M, No. 6 finish (dull satin).
8. Exposed Surfaces: ASTM A 480/A 480M, No. 7 finish (reflective, directional polish).
9. Exposed Surfaces: ASTM A 480/A 480M, No. 8 finish (mirrorlike reflective, nondirectional polish).
10. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Carbon-Steel Sheets: ASTM A 1008/A 1008M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

1. Minimum Thickness: 0.043 inch (1.09 mm).

C. Galvanized-Steel Sheet: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation.

1. Minimum Thickness: 0.052 inch (1.32 mm).

D. Zinc-Coated Steel Shapes: ASTM A 36/A 36M, zinc coated according to ASTM A 123/A 123M requirements.

E. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer's full range.
2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

F. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch (3-mm) thickness that does not chip, flake, or blister.

G. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.2 GENERAL HOOD FABRICATION REQUIREMENTS

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.

1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A 780/A 780M.

B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.

J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

K. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of 3 inches (75 mm).
3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch- (1.58-mm-) thick, stainless-steel shelf tops.

2.3 TYPE I EXHAUST HOOD FABRICATION

A. 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. Captive-Aire Systems.

B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.

1. Hoods shall be designed, fabricated, and installed according to NFPA 96.
2. Include access panels as required for access to fire dampers and fusible links.
3. Duct Collars: Minimum 0.0598-inch- (1.5-mm-) thick steel at least 3 inches (75 mm) long, continuously welded to top of hood and at corners. Fabricate a collar with a 0.5-inch- (13-mm-) wide duct flange.
4. Duct-Collar Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.

a. Collar: Minimum 0.0598-inch- (1.5-mm-) thick stainless steel, at least 3 inches (75 mm) long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum 0.5-inch- (13-mm-) wide duct flange.
b. Blades: Minimum 0.1046-inch- (2.7-mm-) thick stainless steel, counterbalanced to remain closed after actuation.
c. Blade Pivot and Spring: Stainless steel.
d. Fusible Link: Replaceable, 212 deg F (100 deg C) rated.

5. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.

a. Fire Rating: 1-1/2 hours.
b. Frame: SMACNA Type A, with blades in airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners.
c. Blades: Roll-formed, interlocking or folded, minimum 0.034-inch- (0.86-mm-) thick, galvanized-steel sheet.
d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
e. Fusible Link: Replaceable, 165 deg F (74 deg C) rated.

C. Hood Configuration: Exhaust and makeup air.

1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.

D. Hood Style: Wall-mounted canopy.

E. Filters/Baffles: Removable, aluminum, with spring-loaded fastening. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.

F. Lighting Fixtures: Recessed, incandescent fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc (753 lx) at 30 inches (762 mm) above finished floor.

1. Light switches shall be mounted on front panel of hood canopy, on wall adjacent to hood, or in hood control panel.
2. Lighting Fixtures: Incandescent complying with UL 1598.

G. Comply with requirements in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for hood controls.

H. Hood Controls: Hood-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.

1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Motor starters shall comply with Division 26 Section "Enclosed Controllers."

2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
3. Photocell and Temperature Control: Cycle makeup air and exhaust-air fans on and off, based on temperature at hood discharge and opacity of smoke in hood. Interlock fan control with fire-suppression system to operate during fire-suppression-agent release and to remain in operation until manually stopped. Provide air-purge fan and conduit to photocell and reflector to avoid grease accumulation that will negatively affect performance of system.
4. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

I. Capacities and Characteristics:

1. Nominal Hood Length: See Drawings.
2. Nominal Hood Width: See Drawings.
3. Canopy Height: See Drawings.
4. Exhaust Airflow: See Drawings.
5. Exhaust-Air Pressure Loss: See Drawings.
6. Makeup Air Airflow: See Drawings.
7. Makeup Air Pressure Loss: See Drawings.

2.4 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

A. 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. Ansul Incorporated; a Tyco International Ltd. Company.

B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

1. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood or wall. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve; refer to Division 23 Section "Facility Natural-Gas Piping."
6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.

8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.
2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.

B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.

C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.

D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.

E. Install hoods to operate free from vibration.

F. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches (1200 mm) o.c. maximum.

G. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

H. Install lamps, with maximum recommended wattage, in equipment with integral lighting.

I. Set initial temperatures, and calibrate sensors.

J. Set field-adjustable switches.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping with clearance to allow service and maintenance.

C. Install reduced-pressure backflow preventer on washer-water supply. Backflow preventer is specified in Division 22 Section "Domestic Water Piping Specialties."

D. Install washer-water drain piping full size of hood connection to an adjacent floor drain or floor sink.

E. Makeup Water Connection: Comply with applicable requirements in Division 22 Section "Domestic Water Piping Specialties" for valves and accessories on piping connections to water-cooled units.

F. Connect ducts according to requirements in Division 23 Section "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.

G. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial kitchen hoods. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 233813

SECTION 234100 - PARTICULATE AIR FILTRATION

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. Flat panel filters.
2. Pleated panel filters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

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. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

C. Comply with NFPA 90A and NFPA 90B.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 FLAT PANEL FILTERS

A. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AAF International.
b. Flanders-Precisionaire.

B. Filter Unit Class: UL 900, Class 1.

C. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Media shall be coated with an antimicrobial agent.
3. Metal Retainer: Upstream side and downstream side.

D. Filter-Media Frame: Cardboard with perforated metal retainer sealed or bonded to the media.

E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

F. Capacities and Characteristics:

1. Face Area:
2. Face Dimensions:
3. Depth: 1”
4. System Airflow:
5. Maximum or Rated Face Velocity:
6. Arrestance: 85 percent when tested according to ASHRAE 52.1.
7. MERV Rating: 6 when tested according to ASHRAE 52.2.

2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AAF International.
b. Flanders-Precisionaire.

B. Filter Unit Class: UL 900, Class 1.

C. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Media shall be coated with an antimicrobial agent.
3. Separators shall be bonded to the media to maintain pleat configuration.
4. Welded wire grid shall be on downstream side to maintain pleat.
5. Media shall be bonded to frame to prevent air bypass.
6. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer or Aluminized steel with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles sealed or bonded to the media.

E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

F. Capacities and Characteristics:

1. Face Area:
2. Face Dimensions:
3. Thickness or Depth: 2 inches (50 mm).
4. Surface Area:
5. Holding Frame Size:
6. Number of Filters: 1
7. System Airflow:
8. Maximum or Rated Face Velocity:
9. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm (2.5 m/s).
10. Arrestance: 85 percent when tested according to ASHRAE 52.1.
11. Initial Resistance: 0.25-inch wg (62 Pa) at 500 fpm (2.5 m/s).
12. Recommended Final Resistance: 0.5 inches wg.
13. MERV Rating: 7 when tested according to ASHRAE 52.2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Coordinate filter installations with duct and air-handling-unit installations.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged, refrigerant compressor and condenser units.

1.3 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Credit EA 4: Documentation indicating that compressor and condenser units and refrigerants comply.

C. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.
5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 1 TO 5 TONS (3.5 TO 17.6 kW)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Daikin McQuay; Commercial HVAC Systems.
2. Carrier Corporation; Commercial HVAC Systems
3. Trane; a business of American Standard Companies.
4. YORK; a Johnson Controls company.

B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: Two speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
3. Accumulator: Suction tube.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

F. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection and ball bearings.

G. Accessories:

1. Coastal Filter: Mesh screen to protect condenser coil from salt damage.
2. Crankcase heater.
3. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
4. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
5. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
6. Filter-dryer.
7. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
8. Liquid-line solenoid.
9. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
10. Precharged and insulated suction and liquid tubing.
11. Thermostatic expansion valve.
12. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
13. Reversing valve.

H. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.2 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS (21 TO 422 kW)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Daikin McQuay; Commercial HVAC Systems.
2. Carrier Corporation; Commercial HVAC Systems
3. Trane; a business of American Standard Companies.
4. YORK; a Johnson Controls company.

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic or semihermetic rotary screw compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: On-off compressor cycling, Variable-frequency controller, and Hot-gas bypass.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

F. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:

1. Permanently lubricated, ball-bearing totally enclosed motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:

1. Magnetic contactors for compressor and condenser fan motors.

H. Accessories:

1. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
2. Hot-gas bypass kit.
3. Part-winding-start timing relay, circuit breakers, and contactors.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.

2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
5. Condenser coil grille.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 210/240.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated.

B. Install roof-mounting units on equipment supports specified in Section 077200 "Roof Accessories."

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Comply with requirements for piping in other Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

   a. Inspect for physical damage to unit casing.
   b. Verify that access doors move freely and are weathertight.
   c. Clean units and inspect for construction debris.
   d. Verify that all bolts and screws are tight.
   e. Adjust vibration isolation and flexible connections.
   f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
3. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
4. Product Data for Credit IEQ 1: Documentation indicating that units are equipped with a direct outdoor airflow-measuring device capable of measuring the minimum outdoor airflow with accuracy within 15 percent of the design minimum airflow rate, as defined by ASHRAE 62.1.
5. Product Data for Credit IEQ 5: Documentation indicating that units include MERV 13 filters rated according to ASHRAE 52.2.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:

a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For dedicated outdoor-air units, 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. DAIKIN McQUAY
2. Addison.
3. Desert Aire.
4. Engineered Air.
5. LCSystems.
6. Munters Corporation, Dehumidification Division; Des Champs Products.
7. Thomas & Betts Corporation; Reznor HVAC Division.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wind restraints.

C. Wind-Restraint Performance:

1. Basic Wind Speed: 170 MPH.

2. Building Classification Category: IV.
3. Minimum 10 lb/sq. ft multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal.

D. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Maximum Overall U-Value: 0.10 Btu/h x sq. ft. x deg F.
3. Include effects of metal-to-metal contact and thermal bridges in the calculations.

E. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

F. Maximum Cabinet Leakage: 0.5 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

G. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:

   a. Service personnel.
   b. Internal components.
   c. Design working pressure defined for the walls and roof.

H. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Construction: Double wall.

B. Exterior Casing Material: Galvanized steel with paint finish or stainless steel.

C. Interior Casing Material: Galvanized or stainless steel.

D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

E. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

G. Roof: Standing seam or membrane; sloped to drain water.

H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

I. Cabinet Insulation:

1. Type: Fibrous-glass duct lining complying with ASTM C 1071, Type II or flexible elastomeric insulation complying with ASTM C 534, Type II, sheet materials.
2. Thickness: 2 inches (50 mm).
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

J. Condensate Drain Pans:

1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

   a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
   b. Depth: A minimum of 2 inches deep.

3. Configuration: Single wall.
4. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
5. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
6. Material: Stainless-steel sheet.
7. Drain Connection:

   a. Located on one end of pan, at lowest point of pan.
   b. Terminated with threaded nipple.
   c. Minimum Connection Size: NPS 1.

8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

L. Roof Curb: Full-perimeter curb of sheet metal, minimum 12 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

1. Comply with requirements in "The NRCA Roofing Manual."

2.4 SUPPLY FAN

A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.

1. Fan Wheel Material: Galvanized Coated steel, mounted on solid-steel shaft.
2. Bearings: Self-aligning, permanently lubricated ball bearings.

B. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.

C. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Enclosure: Totally enclosed.
3. Enclosure Materials: Rolled steel.
4. Motor Bearings:
5. Unusual Service Conditions:

a. Ambient Temperature: 95 F.
b. Altitude: 0 fEET above sea level.
c. High humidity.

6. Efficiency: Premium efficient.
7. NEMA Design:
8. Service Factor: 1.15.

D. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with spring isolators.

2.5 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Coil Casing Material: Manufacturer's standard material.

C. Tube Material: Copper.

D. Tube Header Material: Manufacturer's standard material.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for face or row control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

J. Coating: Phenolic epoxy corrosion-protection coating after assembly.

2.6 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief.

D. Refrigerant: R-410A.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.

F. Capacity Control:

1. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification on a single compressor.

G. Refrigerant condenser and reheat condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
2. Tube Material: Copper.
3. Fin Material: Aluminum..
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.
6. Coating: Phenolic epoxy corrosion-protection coating after assembly.

H. Condenser Fan Assembly:

1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
    c. Enclosure Materials: Cast aluminum.
    d. Motor Bearings: Permanently lubricated bearings.
    e. Unusual Service Conditions:

        1) Ambient Temperature: 95 F.
        2) Altitude: 0 feet above sea level.
        3) High humidity.

    f. Built-in overcurrent and thermal-overload protection.
    g. Efficiency: Premium efficient.
    h. NEMA Design:
    i. Service Factor:

3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.7 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

1. Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Tubular-Steel Sheath: Compacted magnesium oxide powder.
3. Fins: Spiral-wound, copper-plated, steel fins continuously brazed to sheath.
4. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
5. Safety Controls:

    a. Blower-motor interlock, air-pressure switch.
    b. Quiet mercury contactors.
    c. Time delay between steps.
    d. Integral, nonfused power disconnect switch.

2.8 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.9 FILTERS

A. Cleanable Filters: 2-inch thick, cleanable metal mesh.

B. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, viscous-coated, flat-panel type.
3. Thickness: 2 inches.
4. Initial Resistance: 0.5 inches wg.
5. Recommended Final Resistance: 1.0 inches wg.
6. Minimum Arrestance: 80, according to ASHRAE 52.1.
7. Minimum Merv: 6, according to ASHRAE 52.2.
8. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.

2.10 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Lights: Factory wire unit-mounted lights.

K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

L. Control Relays: Auxiliary and adjustable time-delay relays.

2.11 CONTROLS

A. Control Valves: Comply with requirements in Section 230900 "Instrumentation and Control for HVAC."

B. Control Wiring: Factory wire connection for controls' power supply.

C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

D. Unit-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Status Lights:

a. Filter dirty.
b. Fan operating.
c. Cooling operating.
d. Heating operating.
e. Smoke alarm.
f. General alarm.
g. <Insert points>.

4. Digital Numeric Display:

    a. Outdoor airflow.
    b. Supply airflow.
    c. Outdoor dry-bulb temperature.
    d. Outdoor dew point temperature.
    e. Space temperature.
    f. Supply temperature.
    g. Space relative humidity.
    h. Space carbon dioxide level.
    i. <Insert points>.

E. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Galvanized steel or stainless steel.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Galvanized steel or stainless steel.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement:

    a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
    b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
    c. Accuracy of flow measurement: Within 5 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
    d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
    e. flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

F. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in [60] [90] <Insert value> seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

G. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F .
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

H. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge or remote sensor for field installation in supply-air duct with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Wall-mounted, space-temperature sensor with temperature adjustment or unit-mounted temperature adjustment to control electric coil to maintain temperature.
3. Capacity Controls: Modulating SCR.

I. Damper Controls: Space pressure sensor modulates outdoor- and return-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.

J. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230900 "Instrumentation and Control for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:

a. Room temperature.
b. Discharge-air temperature.
c. Refrigeration system operating.
d. Furnace operating.
e. Constant and variable motor loads.
f. Variable-frequency-controller operation.
g. Cooling load.
h. Economizer cycles.
i. Air-distribution static pressure and ventilation-air volumes.

K. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.

1. Hardwired Points:

a. Monitoring: On-off status, common trouble alarm.
b. Control: On-off operation, space temperature set-point adjustment, supply temperature set-point adjustment, space humidity set-point adjustment.

2. ASHRAE 135 (BACnet) or Industry-accepted, open-protocol communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.12 ACCESSORIES

A. Service Lights and Switch: Factory installed in fan and coil sections with weatherproof cover. Factory wire lights to a single-point field connection.

B. Duplex Receptacle: Factory mounted in unit supply-fan section and refrigeration section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."

C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

D. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

E. Install 3000-psi, compressive-strength (28-day) concrete base inside roof curb, 4 inches thick. Concrete and reinforcement are specified with concrete.

F. Install separate devices furnished by manufacturer and not factory installed.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

H. Install drain pipes from unit drain pans to sanitary drain.

1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.
2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance. Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties."

B. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
3. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

4. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

5. Inspect casing insulation for integrity, moisture content, and adhesion.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean coils and inspect for construction debris.
10. Inspect and adjust vibration isolators and seismic restraints.
11. Verify bearing lubrication.
12. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
13. Adjust fan belts to proper alignment and tension.
14. Start unit.
15. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
16. Operate unit for run-in period.
17. Calibrate controls.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
20. Verify operational sequence of controls.
21. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within **12** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

SECTION 238123 - COMPUTER-ROOM AIR-CONDITIONERS, FLOOR MOUNTED UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Floor-mounted computer-room air conditioners, 6 tons (21 kW) and larger.

1.3 DEFINITION

A. BAS: Building automation system.

1.4 PERFORMANCE REQUIREMENTS

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5- "Systems and Equipment."

C. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For computer-room air conditioners, 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.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.8 COORDINATION

A. Coordinate layout and installation of computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED UNITS 6 TONS (21 kW) AND LARGER

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Data Aire Inc.
2. Liebert Corporation.
3. Stulz-ATS.

B. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.

C. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.

1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
2. Insulation: Thermally and acoustically insulate cabinet interior with 1-inch- (25-mm-) thick duct liner.
3. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color as selected from manufacturer's standard colors.
5. Floor Stand: Welded tubular steel, with adjustable legs and vibration isolation pads.

D. Supply-Air Fan(s):

1. Double-inlet, forward-curved centrifugal fan(s); statically and dynamically balanced.
2. Drive: V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable- and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.

E. Refrigeration System:

1. Compressors: Semihermetic reciprocating; with suction-gas-cooled, 1750-rpm motors; thermal overloads; oil sight glass; suction-line strainer; and reversible oil pumps; with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch.

2. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. Refrigerant: R-410A.
4. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.

    a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

5. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube aluminum-fin coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel and disconnect switch. Control capacity by modulating fan speeds.

F. Electric-Resistance Heating Coil: Enclosed finned-tube electric elements arranged for minimum of three stages, with thermal safety switches, manual-reset overload protection, and branch-circuit overcurrent protection.

G. Extended-Surface, Disposable, Panel Filter: Pleated, lofted, nonwoven, reinforced cotton fabric; supported and bonded to welded-wire grid; enclosed in cardboard frame with 2-inch-(50-mm-) thick, disposable, glass-fiber prefilter.

1. Thickness: 2 inches (50 mm).
2. Initial Resistance: 0.25 inches wg.
3. Recommended Final Resistance: 0.50 inches wg.
4. Arrestance (ASHRAE 52.1): 90 percent.
5. Merv (ASHRAE 52.2): 7.

H. Infrared Humidifier: High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; prepiped and using condensate water from cooling coils with stainless-steel or brass float-valve mechanism; located in bypass airstream; with flush-cycle timer and solenoid drain valve.

I. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.

J. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

K. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.

1. Monitor Panel: Backlighted, with no visible indicator lights until operating function is activated; indicators include cooling, humidification, loss of airflow, change filters, high

temperature, low temperature, high humidity, low humidity, high head pressure (each compressor), and low suction pressure (each compressor).

2. Temperature- and Humidity-Control Modules: Solid state, plug-in; with adjustable set point, push-to-test calibration check button, and built-in visual indicators to show mode of operation.
3. Location: Behind hinged door in front of unit; isolated from conditioned airstream to allow service while system is operating.

L. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

1. Malfunctions:

   a. Power loss.
   b. Loss of airflow.
   c. Clogged air filter.
   d. High room temperature.
   e. Low room temperature.
   f. High humidity.
   g. Smoke/fire.

2. Digital Display:

   a. Control power on.
   b. Humidifying.
   c. Dehumidifying.
   d. Compressor No. 1 - Operating.
   e. Compressor No. 2 - Operating.
   f. Heat operating.
   g. Economy cooling.

3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.
4. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.

   a. Hardwired Points:

      1) Monitoring: On-off status, common trouble alarm, space temperature, and space relative humidity.
      2) Control: On-off operation, space temperature set-point adjustment and space relative humidity set-point adjustment.

   b. Industry-accepted, open-protocol communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator

workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.2 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.3 CAPACITIES AND CHARACTERISTICS

A. Unit Configuration:

1. Upflow.
2. Draw through.

B. Supply-Air Fan:
1. Number of Fans: See Mechanical schedule.
2. Airflow: See Mechanical schedule.
3. Minimum Static Pressure: See Mechanical schedule.
4. Motor Size: See Mechanical schedule.

C. Refrigeration System:
1. Unit Energy Efficiency: See Mechanical schedule.
2. Refrigerant Compressor:
3. Total Unit Cooling Capacity: See Mechanical schedule.
4. Sensible Unit Cooling Capacity: See Mechanical schedule.
5. Number of Compressors: See Mechanical schedule.
6. Motor Size: See Mechanical schedule.

   a. Refrigerant Evaporator Coil:
7. Cooling Capacity: See Mechanical schedule.

   a. Entering-Air Dry-Bulb Temperature: See Mechanical schedule.
   b. Entering-Air Wet-Bulb Temperature: See Mechanical schedule.
   c. Leaving-Air Dry-Bulb Temperature See Mechanical schedule.
   d. Leaving-Air Wet-Bulb Temperature: See Mechanical schedule.

8. Air-Cooled Refrigerant Condenser:

   a. Cooling Capacity See Mechanical schedule.

   b. Entering-Air Temperature: See Mechanical schedule.

c. Number of Condenser Fan Motors: See Mechanical schedule.

d. Condenser Fan Motors: See Mechanical schedule..

D. Electric-Resistance Heating Coil:

1. Total Capacity: See Mechanical schedule.
2. Stages of Heating: See Mechanical schedule.

E. Humidifier:
1. Total: See Mechanical schedule
2. Input: See Mechanical schedule

F. Electrical Characteristics:
1. Volts: See Mechanical schedule
2. Phase: See Mechanical schedule Hertz: 60.
3. Full-Load Amperes See Mechanical schedule
4. Minimum Circuit Ampacity: See Mechanical schedule
5. Maximum Overcurrent Protection: See Mechanical schedule

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.

B. Computer-Room Air-Conditioner Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

1. Minimum Deflection: 1/4 inch (6 mm).

C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

1. Minimum Deflection: 1/4 inch (6 mm).

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Condenser-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping." and Section 232116 Hydronic Piping Specialties." Provide shutoff valves in water inlet and outlet piping on water-cooled units.

E. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Daikin McQuay
2. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division
4. SANYO North America Corporation; SANYO Fisher Company.
5. Trane; a business of American Standard companies.
6. YORK; a Johnson Controls company.

2.2 INDOOR UNITS 5 TONS (18 kW) OR LESS

A. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

   a. Discharge Grille: Steel with surface-mounted frame.
   b. Insulation: Faced, glass-fiber duct liner.
   c. Drain Pans: Galvanized steel, with connection for drain; insulated.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Electric Coil: Helical, nickel-chrome, resistance-wire 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.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:

   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

6. Air Filtration Section:

   a. General Requirements for Air Filtration Section:

      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

1) Factory-fabricated, viscous-coated, flat-panel type.
2) Thickness: 1 inch (25 mm).
3) Dust-Holding Capacity:
4) Initial Resistance: 0.25inches wg.
5) Recommended Final Resistance: 0.5 inches wg.
6) Arrestance according to ASHRAE 52.1: 80.
7) Merv according to ASHRAE 52.2: 5.
8) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
9) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 INDOOR UNITS (6 TONS (21 kW) OR MORE)

A. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

a. Discharge Grille: Steel with surface-mounted frame.
b. Insulation: Faced, glass-fiber duct liner.

2. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 2 inches (50 mm) deep.

b. Single-wall, stainless-steel sheet.
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1 (DN 25).

d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.

4. Electric Coil: Helical, nickel-chrome, resistance-wire 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.
5. Fan: Direct drive, centrifugal.
6. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Enclosure Type: Totally enclosed, fan cooled.
    d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    f. Mount unit-mounted disconnect switches on exterior of unit.

7. Air Filtration Section:

    a. General Requirements for Air Filtration Section:

        1) Comply with NFPA 90A.
        2) Minimum Arrestance: According to ASHRAE 52.1 and a MERV according to ASHRAE 52.2.
        3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

    b. Disposable Panel Filters:

        1) Factory-fabricated, viscous-coated, flat-panel type.
        2) Thickness: 1 inch (25 mm).
        3) Dust-Holding Capacity:
        4) Initial Resistance: 0.25inches wg.
        5) Recommended Final Resistance: 0.5 inches wg.
        6) Arrestance according to ASHRAE 52.1: 80.
        7) Merv according to ASHRAE 52.2: 5.
        8) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
        9) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

B. Variable-Frequency Controllers:

1. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, three-phase induction motor by adjusting output voltage and frequency.
2. Output Rating: Three-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

3. Unit Operating Requirements:

    a. Input ac voltage tolerance of 208 V, plus or minus 5 percent.
    b. Input-frequency tolerance of 50/60 Hz, plus or minus 6 percent.
    c. Minimum Efficiency: 96 percent at 60 Hz, full load.
    d. Minimum Displacement Primary-Side Power Factor: 96 percent.
    e. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
    f. Starting Torque: 100 percent of rated torque or as indicated.
    g. Speed Regulation: Plus or minus 1 percent.

4. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
5. Internal Adjustability Capabilities:

    a. Minimum Speed: 5 to 25 percent of maximum rpm.
    b. Maximum Speed: 80 to 100 percent of maximum rpm.
    c. Acceleration: 2 seconds to a minimum of 22 seconds.
    d. Deceleration: 2 seconds to a minimum of 22 seconds.
    e. Current Limit: 50 percent to a minimum of 110 percent of maximum rating.

6. Self-Protection and Reliability Features:

    a. Input transient protection by means of surge suppressors.
    b. Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
    c. Instantaneous line-to-line and line-to-ground overcurrent trips.
    d. Loss-of-phase protection.
    e. Reverse-phase protection.
    f. Short-circuit protection.
    g. Motor overtemperature fault.

7. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads, spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
8. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.
9. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
10. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back, based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
11. Door-mounted, digital status lights shall indicate the following conditions:

    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.

f. External fault.

12. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed-time meter.
13. Meters or digital readout devices and selector switch, mounted flush in controller door and connected, to indicate the following controller parameters:

    a. Output frequency (Hertz).
    b. Motor speed (rpm).
    c. Motor status (running, stop, fault).
    d. Motor current (amperes).
    e. Motor torque (percent).
    f. Fault or alarming status (code).
    g. Proportional-integral-derivative feedback signal (percent).
    h. DC-link voltage (volts dc).
    i. Set-point frequency (Hertz).
    j. Motor output voltage (volts).

14. Control Signal Interface:

    a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
    b. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:

        1) 0 to 10-V dc.
        2) 0-20 or 4-20 mA.
        3) Potentiometer using up/down digital inputs.
        4) Fixed frequencies using digital inputs.
        5) RS485.
        6) Keypad display for local hand operation.

    c. Output signal interface with a minimum of one analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hertz).
        2) Output current (load).
        3) DC-link voltage (volts dc).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hertz).

    d. Remote indication interface with a minimum of two dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

        1) Motor running.
        2) Set-point speed reached.
        3) Fault and warning indication (overtemperature or overcurrent).
        4) High- or low-speed limits reached.

15. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
16. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
17. Accessories:

    a. Devices shall be factory installed in controller enclosure unless otherwise indicated.
    b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
    c. Standard Displays:

        1) Output frequency (Hertz).
        2) Set-point frequency (Hertz).
        3) Motor current (amperes).
        4) DC-link voltage (volts dc).
        5) Motor torque (percent).
        6) Motor speed (rpm).
        7) Motor output voltage (volts).

2.4 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, 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.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.5 OUTDOOR UNITS (6 TONS (21 kW) OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, 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.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Charge: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
6. Mounting Base: Polyethylene.

2.6 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. 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.

D. Drain Hose: For condensate.

E. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.7 CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity:

1. Total: See Drawings.
2. Sensible: See Drawings.
3. SEER: See Drawings.
4. EER: See Drawings.
5. Moisture Removal: See Drawings.
6. Entering-Air Temperature:

a. Dry Bulb: See Drawings
b. Wet Bulb: See Drawings

7. Leaving-Air Temperature:

a. Dry Bulb: See Drawings
b. Wet Bulb: See Drawings

B. Heating Capacity:

1. Type: Electric.
2. Total Capacity: See Drawings.
3. Air-Temperature Rise:
4. Coefficient of Performance: See Drawings.
5. Heating Season Performance Factor: See Drawings.
6. Electric Heating Coil:

a. Total Capacity: See Drawings.
b. Volts: 208.
c. Phase: Single.
d. Hertz: 60.
e. Steps: Two.

C. Indoor Unit:

1. Fan Motor Electrical Characteristics:

a. Volts: 208.
b. Phase: Single.
c. Hertz: 60.

2. Airflow: See Drawings.

D. Outdoor Unit:

1. Type: Air cooled.
2. Electrical Characteristics:

a. Volts: 208.
b. Phase: Single.
c. Hertz: 60.
d. Minimum Circuit Ampacity: See Drawings.
e. Maximum Overcurrent Protection: See Drawings.
f. Fan Motor Full-Load Amperes: See Drawings.
g. Compressor Full-Load Amperes: See Drawings.
h. Compressor Locked-Rotor Amperes: See Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories."Section 07720 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate size and location of wall sleeves for outdoor-air intake.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Compressor failure.
   b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
4. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In the Fan-Coil-Unit Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each fan-coil unit is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 FAN-COIL UNITS

A. Basis-of-Design Product: Carrier Corporation or a comparable product by one of the following:

1. Daikin McQuay.
2. Trane.
3. Carrier Corporation.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch (13-mm) thick, foil-covered, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.

E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

F. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect.

1. Vertical Unit Front Panels: Removable, steel, with steel discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.
2. Steel recessing flanges for recessing fan-coil units into ceiling or wall.

G. Outdoor-Air Wall Box: Minimum 0.1265-inch- (3.2-mm-) thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen.

1. Louver Configuration: Vertical, rain-resistant louver.
2. Louver Material: Aluminum.
3. Bird Screen: 1/2-inch (13-mm) mesh screen on interior side of louver.
4. Decorative Grille: On outside of intake.
5. Finish: Baked enamel, color as selected by Architect from manufacturer's standard colors.

H. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with electronic, modulating actuators.

I. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

K. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

L. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features:

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Automatic changeover.
    e. Adjustable deadband.
    f. Exposed set point.
    g. Exposed indication.
    h. Degree F indication.

3. Wall-mounting temperature sensor.
4. Unoccupied-period-override push button.
5. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

M. Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Outdoor-Air Damper Operation:

    a. Occupied Periods:

        1) Outdoor-Air Temperature below Room Temperature: If room temperature is above thermostat set point, modulate outdoor-air damper to maintain room CO2 sensor set points.
        2) Outdoor-Air Temperature above Room Temperature: Position damper to modulate outdoor-air damper to maintain CO2 sensor set points.

    b. Unoccupied Periods: Close damper.

5. Controller shall have volatile-memory backup.

N. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above finished floor.

D. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

SECTION 239000 – VERTICAL AIRFLOW ENGINE EXHAUST REMOVAL SYSTEM

THE FOLLOWING ITEMS SHALL BE SPECIFIED:

- BIDDER TO BE THE DIRECT MANUFACTURER
- BIDDER TO PROVIDE "ONLY ONE PRICE" "BEST PRICE OFFERED"
- MANUFACTURER TO HAVE BEEN IN BUSINESS AND SELLING/INSTALLING THE PROPOSED PRODUCT FOR OVER 15+ YEARS.
- MAIN ACTIVATION CONTROL TO BE UL LISTED AND CERTIFIED
- MINIMUM QUANTITY OF UNITS TO BE SPECIFIED (to avoid low balling & insufficient quantities within the station)
- AIR FLOW PATTERN/DESIGN OF UNITS ("Coanda VERTICAL Airflow Pattern" – Vertical Intake, 360º output)
- MAXIMUM EFFICIENCY AND TYPE OF MAIN FILTERS PREVENTS THE INSTALLATION OF LOW EFFICIENCY FILTERS THAT ALLOW BYPASS OF ENGINE EXHAUST, UL CLASS 1 CERTIFIED.
- ACTIVATION DEVICES – AIR VAC RECOMMENDS THE AUTOMATIC ACTIVATION OF SYSTEM THROUGH DOOR SWITCHES AND PHOTO EYES. EACH COMPLIMENT AND BACK-UP THE OTHER IN CASE OF PRODUCT FAILURE.
- A MINIMUM OF 5+ INSTALLATIONS WITHIN THE STATE OF YOUR FIRE DEPARTMENT. PROVIDES INSURANCE OF QUALITY CUSTOMER SERVICE, EXPERIENCE AND "FIELD TESTED" SYSTEM.
- NO ACTIVE LITIGATION AGAINST THE BIDDING COMPANY. PROVIDES INSURANCE OF ANY LEGAL ACTION AGAINST THE BIDDING COMPANY, LIENS ON PRODUCT, ETC.
- INSTALLATION MUST BE PERFORMED BY A MANUFACTURER TRAINED AND EXPERIENCED TEAM. LIST NAME OF INSTALLER, CREDENTIALS AND GIVE EXAMPLES.
- DISCLAIMER CLAUSE: EXAMPLE: "THE FIRE DEPARTMENT/PURCHASING HAS THE FINAL DECISION BASED UPON PRODUCT QUALITY, COMPANY QUALIFICATIONS, ETC. AND NOT NECESSARILY SOLELY UPON THE LOWEST BID PRICE"

INTENT OF THE SPECIFICATIONS:

QUANTITY: 6

It is the intent of these specifications to cover the furnishing and INSTALLATION to the Fire Department, of a complete *VERTICAL AIRFLOW* "AIR VAC-911" Engine Exhaust Removal System for Fire Stations as specified below with the purpose of obtaining the best results and the most acceptable system for service in the Fire Department. These specifications cover the requirements as to conform, together with certain details as to finish, equipment and appliances with which the successful bidder must conform. Minor details of construction and materials where not otherwise specified are left to the discretion of the manufacturer of the system. The manufacturer of the Exhaust Removal System shall be solely responsible for the design and construction of all features.

The Exhaust Removal System shall be a 100% re-circulating, fully automatic, ceiling hung, "Vertical Airflow" filtration system that addresses the problem of diesel/gas fumes in the Fire Station and does not in-

terfere with normal day-to-day operations or vehicles. The system must be designed to evacuate diesel/gas fumes through media filtration and re-circulation of filtered air to the floor area without exhausting contaminants to the outdoor environment. The system is to utilize a Vertical Intake and 360-degree clean air output. The system shall not affect the personnel boarding the apparatus. The exhaust system shall not impede doorways, exits, vehicles and may not consist of any form of direct vehicle attachment.

Each bidder shall furnish satisfactory evidence of his ability to furnish & install the system specified and shall state the location of the factory where the apparatus is to be built. All equipment supplied within the bid shall be specifically designed and proven to be capable of the removal of engine exhaust particulate and gasses.

Each bidder shall be required to submit with their bid, "Contractor Specifications" consisting of a detailed description of the Engine Exhaust Removal System and all equipment proposed and to which the system furnished under contract must conform. These specifications shall indicate size, type, model and make of all component parts and equipment.

QUALITY OF WORKMANSHIP

The workmanship must be of the highest possible. Special consideration will be given to the following points: accessibility to various components which require periodic maintenance, ease of operation/installation, symmetrical proportions, protection of wiring connections against moisture and corrosion, a neat and logical layout of electrical wiring and components, a general logical approach to the layout of controls and equipment and a proven effectiveness of the system within the fire department industry.

Bidder must be the manufacturer of the proposed system to be bid and construction must be rugged and ample, safety factors must be provided to filter contaminated air without damage or modifications to vehicles or the building.

DELIVERY

The bidder shall include a delivery date within the bid. The bidder shall provide all materials herein outlined. We encourage the bidder to verify compatibility with existing electrical systems found at the said Fire Station(s).

BID DOCUMENTS

Each bidder's master proposal shall be arranged in the following order for the bid opening:

1. Total equipment price on the bid sheet provided. FOB destination.
2. Total installation price (separate if need be).
3. List of exceptions
4. Contractor's Specifications

INFORMATION REQUIRED WITH BID

1. One set of "contractors specifications" consisting of a detailed description of the System and related equipment proposed and to which the System furnished under contract MUST CONFORM. These specifications shall indicated size, type, model, and make of all components, parts, and equipment. All contractors' specifications shall be prepared in the EXACT SAME ORDER as the City of Pompano Beach specifications. FAILURE TO DO SO SHALL CAUSE AUTOMATIC REJECTION OF THE BID.

2. A list of exceptions to the purchaser's specifications, under the following rules:

Each bidder shall provide no less than his "standard" equipment, except as modified by this specification. The City of Pompano Beach will not accept an apparatus where items or features have been deleted from a manufacturer's standard.

Exceptions to the specifications will not be accepted and shall be listed individually by the bidder. Any exceptions not listed shall be assumed by the purchaser to be included in the bidder's proposal, and the bidder shall conform to the purchaser's specification, regardless of cost to the installer.

3. The bidder shall clearly show on the Bid Sheet the total purchase price for the System + installation per this specification.

Each bidder shall provide a cost breakdown of individual prices of all items in addition to standard, all items in place of standard and any options to the base bid.

4. Minimum of one copy of a typical drawing of the proposed equipment's location shall be provided.

5. The bidder's price shall be valid for no less than 60 days from bid opening date.

6. The bidder shall furnish a list of all past, present and pending legal action that has been brought against the bidder, and resulting court actions.

INFORMATION REQUIRED AT TIME OF DELIVERY/INSTALLATION

1. Minimum of one copy of the operations manual, parts, installation and maintenance manuals

2. Minimum of one copy of electrical components information, for all items purchased for this System.

3. Minimum of one copy of the complete wiring diagram, including control panel and activation devices.

UNITED STATES MANUFACTURER

The entire system shall be built and assembled within the borders of the Continental United States to insure more readily available parts and service, as well as protecting the XYZ Fire Department should legal action ever be required.

WARRANTY

The bidder shall guarantee all materials, equipment, and workmanship for a period of no less than FIVE(5) years, excluding obvious misuse. Warranty is to include all costs for these parts and labor yet, excluding consumable filters. Defects shall be made good at the bidder's expense with no cost or obligation to the owner. Bidder shall not be responsible for system misuse; abuse, and natural disasters, components not operated under normal industry use, has been repaired, altered or modified. If any failure should occur, bidder shall repair or replace (with new or remanufactured parts), at his option, the product without cost. All repairs shall be completed at the original installation site of the product however bidder reserves the right, at his cost, to remove and return the product to the plant where the product can be inspected, repaired or replaced and then returned and reinstalled. Bidder shall be responsible for all labor costs and transportation costs, including, freight and insurance, in connection with completing a warranty work call. The warranty shall commence on the date of final acceptance.

BIDDER QUALIFICATIONS:

Bids will only be accepted from manufacturing companies that have an established reputation in the business of designing turnkey installations, servicing, and installing AUTOMATIC VERTICAL AIRFLOW ENGINE EXHAUST REMOVAL SYSTEMS (REQUEST PHOTOGRAPHIC PROOF OF EQUIPMENT IN FIELD SHOWING VERTICAL AIRFLOW) for a minimum of no less than ten (10) years. Bidder shall show proof that the system bid has been field tested and proven by supplying a list of no less than 20 different fire department references using the proposed system within this bid (see attachment A). References to include product/model name, equipment manufacturers name, a phone number and contact name and shall be submitted with the bid document.

MANUFACTURER QUALIFICATIONS:

Bids shall only be accepted by bidder's supplying equipment from manufacturers that have an established reputation in the business of manufacturing AUTOMATIC & VERTICAL AIRFLOW ENGINE EXHAUST REMOVAL SYSTEMS for a minimum of no less than fifteen (15) years. System bid shall have a life of service of no less than fifteen (15) years to establish proof of quality, longevity and service. Equipment life of service shall meet the department's expectations for similar types of equipment. No exceptions

REFERENCES

Bidder must supply a list of NO Less than twenty installations of the proposed exhaust removal system within the United States.

EQUIPMENT SPECIFICATIONS

EQUIPMENT TYPE

Quantity: Six (6), 100% re-circulating, VERTICAL AIRFLOW engine exhaust filtration systems shall be delivered & INSTALLED.

Bidder shall comply with specifications.

Bidder MUST show visual proof, photographs, of VERTICAL AIRFLOW engine exhaust filtration systems installed within the field.

OPERATING LOGIC

The operating logic of this system must complete the following cycle. Upon vehicle dispatch or return to the apparatus floor of the fire station, the engine exhaust removal system, shall be automatically activated by low voltage photo electric eyes as specified and magnetic door switches. At such time the filtration system shall run for a minimum period of fifteen (15) minutes to assure collection of exhaust gases and particulate.

UNIT SECTION

Unit cabinet shall be manufactured with all welded, 18 and 16 gauge steel construction. Internal "dual-pan" construction consisting of 16 gauge steel to eliminate vibration noise created by air and motor movement.

Each unit must be provided with four 2" x 2" x 3/16" thick mounting angles with predrilled 3/8" hole to accept threaded rod.

Each unit is to be constructed with four, fully adjustable, lateral airflow grilles. Dimensions: ID - 16" x 6", OD - 18" x 8", aluminum alloy with 200-R1 satin anodized finish. The frame has a typical wall thickness of .050" and is separated from the blades with injection molded nylon bushings. All blades are airfoil in design, individually adjustable and spaced 3/4" on center.

Each unit is to consist of Two (2), hinged access panels: (1) Top panel to allow access to motor blower unit & One (1) Bottom panel to allow easy access to the filter holding compartment.

Cabinet finish shall consist of gray industrial powder coat, baked finish.

Cabinet dimensions OD are NOT to exceed 25" wide x 26" deep x 28" high. No exceptions.

Each unit not to exceed 130 pounds w/o filtration and NOT to exceed 190 with filtration.

Each Unit shall include, non-metal & chemically resistant back-curved centrifugal impeller. Maximum Dimensions: 14" x 7.52" with 5/8" bore with appropriate plastic "air flow" funnel cone.

Each unit shall be powered by a: 3/4 HP, 1725 RPM, single phase, resilient mounted, capacitor start-type, ball bearing, automatic thermal protection, dual voltage 115/208-230 V., U.L. approved electric motor.

Minimum of ONE (1) unit (one per building section) shall be equipped with a "Dwyer", minihelic static pressure-drop gauge. Dimensions NOT to exceed: Face - $2^{29}/32$". Housing: glass filled nylon; polycarbonate lens. Finish: black. Weight: 6 oz.

FILTRATION

Each unit shall include a complete set “4-stage” of HVAC industry standard sized filters classified and tested as follows:

Prefilter shall consist of 3-Ply polyester construction. Self-sealing, two layers of 16/40 dual denier poly fibers. An additional case of twelve (12) replacement prefilters shall accompany the equipment. Each filter consists of an internal heavy gage, wire frame. ASHRAE certified to be 30-35% efficient based on 52.1-1992 test methods. Classified as a U.L. CLASS 2 filter. SIZE: 24" x 24" x 1".

MAIN MEDIA FILTER (STAGE 2):
24" X 24" X 6". “HEPA MAX 3000” HIGH EFFICIENCY PARTICULATE AIR FILTER. DOP TESTED WITH 0.3 MICROMETER SIZED PARTICLES TO HAVE A MINIMUM EFFICIENCY OF UP TO 95% AND EXCEEDS THE MAXIMUM EFFICIENCY OF 98% ASHRAE 52.1 TESTED FILTERS. CONSISTS OF A PLEATED MEDIA PACK ENCLOSED WITHIN A GALVANIZED STEEL FRAME ASSEMBLY. ULTRA-FINE FIBERGLASS MEDIA FORMED IN A SERIES OF PLEATS SEPERATED BY CORRUGATED ALUMINUN DIVIDERS TO MAINTAIN UNIFORM SPACING BETWEEN EACH PLEAT FOR OPTIMAL AIRFLOW. CLASSIFFIED CLASS 2 ACCORDING TO U.L. STANDARD 900 AND IS CLASSIFIED MERV 16 IN ACCORDANCE WITH ASHRAE STANDARD 52.2. FOR INSTALLATION SAFETY, TOTAL WEIGHT NOT TO EXCEED 16 LBS.MUST NOT EXCEED SIZE: 24" x 24" x 6". No exceptions

Carbon Phase (gas absorption phase) filtration shall consist of: GAS-PHASE EXTRACTOR (STAGES 3&4):
ONE 24" X 24" X 4", “MULTISORB 3000” BLENDED GAS PHASE EXTRACTOR. 50/50 RESPIRATOR GRADE ACTIVATED CARBON GRANUALS EFFECT FOR REMOVAL OF HIGH WEIGHT MOLECULAR GASES WITHIN DIESEL EXHAUST (VOC’S, HYDROCARBONS, BENZENE, OCTANE, METHANOL AND MORE) AND POTASSIUM PERMANGANATE FOR REMOVAL OF LIGHT WEIGHT MOLECULAR GASES (*SULFUR DIOXIDE, NITROGEN DIOXIDE, FORMALDEHYDE AND MORE*). EACH FILTER IS CONSTRUCTED WITHIN A 24ga METAL FRAME WITH INTERNAL "HONEYCOMB" CONTAINMENT STRUCTURE. 50/50 BLEND EQUATES TO 14 LBS EACH. FOR INSTALLATION SAFETY, TOTAL WEIGHT NOT TO EXCEED 28 LBS.

MASTER CONTROL PANEL

Controller: Built and supplied by a UL recognized and listed exhaust system manufacturer. Controller shall carry the UL listing label as an “Enclosed Industrial Control Panel.” Individual components listed by UL - CUL shall not satisfy the above requirement. Manufacturer shall undergo monthly inspections by UL to verify all requirements and standards are met as outlined by UL. No exceptions.

Electrical Controllers: Electrical controller and manufacturer shall be recognized and listed by UL. Controller shall be manufactured in accordance with Underwriters Laboratories standard UL-508 for “Enclosed Industrial Control Panels”. Enclosures shall be minimum NEMA 4 rated. No exceptions.

Shall be model AVEC or better.

Must be constructed within a minimum NEMA 4 rated enclosure (no exceptions) & contain stainless steel hinge and screw cover, to restrict access of internal components. Shall be designed to operate a max-

imum of six (6) filtration units and shall be designed to sequentially activate the units in blocks of two's when installing 5 or more units.

Control shall consist of one adjustable low voltage time delay relay.

Control shall consist of one (1) front panel led "system activated" indication light.

Control shall consist of One (1) "ON-OFF" override, and "AUTO ON" three position toggle switch.

Control shall consist of One (1) "system test" switch. This momentary switch is to activate the system for a timed cycle.

Control shall be designed with a 24 VAC-2 AMP low voltage transformer for use as an auxiliary peripherals power supply, for powering specific field devices, such as photo beams.

Control shall be fully labeled indicating: purpose of external switching devices, manufactures name and phone number and consist of complete instructions and wiring schematic affixed to the inside cover.

Shall provide necessary quantities of low voltage switching devices as requested by manufacturer.

Model: PB030TK Photo Electric Eye, Indoor range 200' or better, photoelectric activation switches two (2) per station

Model: N505ATM/ST SET WITH TRACK MOUNT BRACKET 2" to 3.25" or better, magnetic door track activation switches one per overhead door.

INSTALLATION-WIRING

Shall be a 20-AMP, 120-VOLT, 60 HZ. dedicated line, encased within electro metallic (EMT) tubing to a grounded outlet box above each units location. A 12/2-switch leg will then run from each unit's location back to Air Vac control panel "Smart Timer". Low voltage wiring must be connected to the proper terminals within the control panel and run accordingly to the activation device(s) used. All wiring, including low voltage wiring for activation switching, must meet national, state and local codes.

INSTALLATION-HANGING

THE INSTALLER SHALL PROVIDE A SAFE AND STURDY MOUNT FROM THE CEILING SUPPORTS VIA, PRE-DRILLED UNISTRUT, BOLTING DIRECTLY TO EXISTING CEILING JOIST/TRUSS OR OTHER ACCEPTABLE MEANS. THE INSTALLATION SHALL PROVIDE A SAFE AND RUGGED MOUNT FOR EACH INDIVIDUAL UNIT. EACH UNIT SHALL BE INSTALLED AND HUNG USING MINIMUM 3/8" TO 5/8" THREADED ROD TO EACH OF FOUR CORNERS OF EACH "AIR VAC-911" UNIT. PRE-DRILLED MOUNTING BRACKETS SHALL BE PROVIDED BY THE MANUFACTURER AT THE PROPER LOCATIONS FOR EACH UNIT (TOP CORNER EACH).

REFERENCE LIST

CONTACT NAME	FIRE DEPT.	ADDRESS	MODEL	PHONE
TONY VITKO	100 BLOCK NORTH OCEAN BLVD		AIRVAC 911	1-800-540-7264

END OF SECTION 239000

SECTION 239005 – GENERAL SPECIFICATIONS FOR AIR FILTRATION AND PURIFICATION SYSTEM DESIGNED FOR ENGINE EXHAUST REMOVAL

Scope

Provide the equipment, delivery and installation of an air filtration system as specified. The air filtration system shall include an activation system to automatically start the equipment to capture, reduce or eliminate the vehicle exhaust products from the apparatus and contaminants generated by other sources. Contaminants may consist of airborne engine vapors, diesel exhaust, soot, gases, carbon monoxide, nitrous dioxide, and any other gas or diesel exhaust powered equipment located in the bay area. Additional toxins to be captured must include Volatile Organic Compounds and small respirable particulate.

A peripheral or circular air pattern shall be used to effectively move contaminant from unit to unit. Adequate equipment must be supplied to provide a minimum of ten air changes per hour in the entire bay area. This formula for determining the number of units will be used unless otherwise specified.

The technology desired to capture diesel exhaust soot and gases is a progressive filtration system explained in the following text.

TESTING IN ACTUAL FIRE HOUSE

In order to insure the capability of the system to remove the particulate and gaseous contaminants found in a fire house emergency facility, the system proposed must have been independently tested in an actual fire/rescue bay area producing results that meet OSHA standards. At least one test must have been performed testing for VO, NO2, SO2, CO, and particulars showing acceptable results pertaining to OSHA standards. Test must accompany the bid.

Pre-filter:

Shall be of extended surface pleated type 24 x 24 x 4” (NOM). Media shall be 100% synthetic fibers. An expanded metal reinforcement shall be laminated to the air heavy side. A heavy duty moisture resistant beverage board shall be used to encase the frame. It shall be rated at **MERV 11** where tested in accordance with ASHRAE 52.2 Test Standard.

Primary Filter:

MERV 16, HEPA grade air filter with efficiency based upon 0.3 micron size particle. The filter must be a mini-pleat construction and be made of mechanical media that does not lose efficiency as loading occurs. The media shall be manufactured with high efficiency micro-fiberglass media. Filters that rely on electrostatic properties that dissipate over time to obtain initial high efficiencies are not acceptable. The filter must trap and retain particles to ensure personnel safety. The filter shall have a minimum of 202 square feet of media area and dust holding capacity of 200 grams.

Thermoplastic glue-bead separators are inserted between each pleat to provide an extensive open area for airflow and to stabilize the media pack. A heavy-duty corrosion resistant durable plastic frame encapsulates the media pack. Self extinguishing adhesive shall bond the media pack to the frame. Size shall be 24 x 24 x 12" (NOM).

Photo - Catalytic Oxidation Chamber:

Photo-Catalytic Oxidation (PCO) provides powerful, chemical-free oxidation of volatile organic chemicals (VOC's) and microbes. It changes harmful chemicals into benign carbon dioxide (CO_2) and water. This technology is developed by Sandia Laboratory and the National Renewable Laboratory and used by the Department of Defense for destroying toxic organic compounds (VOC's). It utilizes the activation of a catalytic surface with safe, germicidal UV-C lamps having spectra less than 390 nanometers (nm).

The photo-catalytic oxidation chamber (PCO) shall utilize a grid made of aircraft aluminum honeycomb material with 1/8" cells and ¾" thick. There shall be 70 square feet of surface area. This grid shall be impregnated with titanium dioxide (TiO_2) into the cell area and on the total surface area (70 sq. ft.) of the grid or substrate. This (TiO_2) application shall be rugged enough so as not to flake off or deteriorate over time and should be washable (if necessary) with mild soap, Windex and water.

This surface area of the grid or catalyst shall be illuminated with two UV lamps of at least 3 milliwatts / CM^2. The lamps shall be UV-C 254 nanometers and have a life expectancy of 7000 hours.

Gas-phase Filtration:

The Model 3000XL is equipped with a carbon filter that is a combination 50/50 blend of activated carbon and potassium permanganate on zeolite. The filter media must be of pleated construction. Flat faced filters are not acceptable as they produce excessive static pressure resistance. The housing consists of 23.5"x 23.5" x 7.75" gauge aluminized steel with header that holds eight (8) replaceable disposable trays. The pollutants from diesel exhaust, unspent diesel fuel, sulfur-based compounds, nitric acid, and nitrogen dioxide shall be absorbed into the material and removed from the air stream. The gas phase chamber shall weigh 46 pounds and contain 26 lbs of carbon, potassium permanganate, zeolite blend. Care shall be taken to ensure the preceding filters are properly sealed so as not to contaminate the carbon filter with soot or other debris.

Unit Cabinet:

The cabinet shall be manufactured with 16 gauge steel of clenched or welded construction. Units are to have pre-drilled flanged holder for accepting 3/8" threaded rod for mounting. For ease and safety the unit must have both filter and blower compartment access doors. Door access panels shall be fully hinged for entry to filters and motor blower compartments. Unit shall be equipped with four-way adjustable diffuser grilles manufactured of extruded aluminum. Cabinet finish shall be industrial powder-coated, baked finish.

Motor Blower:

Shall be direct-drive, forward curved blades; 1 HP 1075 RPM, single phase, permanent split – capacitor motor, automatic reset thermal protection. The 1 H.P. motors are ball bearing style, dual voltage 230v, 9 amps respectively.

SOUND LEVEL – db Rating:

Unit sound level rating shall not exceed 64db at 6 ½' under the unit. Provide certification with the bid.

Certification:

The product must be UL or ETL certified as a complete assembly. This will insure that the product has met all the safety standards of the Occupational Safety and Health Administration. The product as a whole shall be manufactured and assembled in an **ISO9001-2008** facility. Certifications must accompany the bid.

Electrical Control Panel

Control panel shall be constructed of polycarbonate NEMA 4X rated enclosure.

- Panel must be UL or ETL certified as a complete assembly.
- Door interlock can be padlocked.
- Master system stop pushbutton on front of cover.

- Run power light/motor overload indicator.
- Internal programmable relay provides easy operational changes as well as a small diagnostic screen for error messages.
- Auto/manual operational selector switch.
- Time boost push button.
- Sequenced motor starting.
- Long range photo electric with easy set-up.
- CO/NO2 monitor ready for connecting as needed or desired.
- LED filter change indicator visible from the floor level mounted on the unit.

Operational Details

Automatic Mode:

The circuit is activated when a vehicle passes and blocks the photoelectric sensor for more than a few seconds. This time delay prevents unintended start ups.

At that point the motors will start to sequence on with a 3-5 second delay between motors. This reduces inrush currents to reduce the possibility of tripping the circuit protections on the main power panel.

The motors will run for the predetermined time which can be factory set for any desired time. This time can also be set in the field, if necessary.

Manual Mode:

In manual mode the motors will run continuously.

Time Boost:

This provides a preset amount of run time for the motors. This cannot automatically time to the auto mode. In fact, it functions only under the following conditions:
Upon depressing the Time Boost the motors will sequence on and run for a predetermined length of time unless the system's stop is pushed or the Auto/Manual selector switch is changed back to the Manual mode. In either case, it causes the Time Boost to reset.

Run Indicator Light:

This light has a dual function. It comes on in a steady state when the first motor starts. The other function provides indication of a motor overload. In this case all the motors stop and the light flashes.

Warranty:

The unit shall include a Limited lifetime warranty on parts and workmanship with a 2 (two) year labor warranty.

References and Installation Proof of Performance:

The manufacturer must show that they have supplied at least 50 like units to a least 10 separate emergency response fire departments. The units must include all filter sections (Pre-Filter Section, Primary Filter Section, Gas Phase Filtration Section, and Photo Catalytic Oxidation Section) previously outlined in the above sections. Manufacturer and supplier must be ISO 9001-2008 certified. Test data must be provided performed by an Independent Industrial Hygienist in an active fire department bay area. The test must include at least 2 apparatus operating at one time without exhaust fans operational to prove the ability of the air cleaning system to maintain a clean air area which meets or exceed existing OSHA requirements.

END OF SECTION 239005

SECTION 239100 – VARIABLE REFRIGERANT FLOW HEAT PUMPS

Daikin North America LLC

HVAC Guide Specifications
Multiple Evaporator, Direct Expansion (DX), Air-Cooled, Variable Capacity, Split System

Size Range: 6 to 34 Tons Nominal

Daikin AC Model Number:
RXYQ72TTJU
RXYQ96TTJU
RXYQ120TTJU
RXYQ144TTJU
RXYQ168TTJU
RXYQ192TTJU (1x RXYQ120TTJU + 1x RXYQ72TTJU)
RXYQ216TTJU (1x RXYQ120TTJU + 1x RXYQ96TTJU)
RXYQ240TTJU (2x RXYQ120TTJU)
RXYQ264TTJU (1x RXYQ144TTJU + 1x RXYQ120TTJU)
RXYQ288TTJU (2x RXYQ144TTJU)
RXYQ312TTJU (1x RXYQ168TTJU + 1x RXYQ144TTJU)
RXYQ336TTJU (2x RXYQ168TTJU)
RXYQ360TTJU (3x RXYQ120TTJU)
RXYQ384TTJU (1x RXYQ168TTJU + 1x RXYQ120TTJU + 1x RXYQ96TTJU)
RXYQ408TTJU (1x RXYQ168TTJU + 1x RXYQ144TTJU + 1x RXYQ96TTJU)

Part 1 – GENERAL

VARIABLE REFRIGERANT VOLUME (VRV IV) AIR CONDITIONING
SPECIFICATION – Heat Pump

1.01 SYSTEM DESCRIPTION
The variable capacity, heat pump air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat or cool model) system as specified. The system shall consist of multiple evaporators using PID control, REFNET™ joints and headers, a two-pipe refrigeration distribution system and Daikin VRV® condenser unit. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. The condensing unit may connect an indoor evaporator capacity up to 200% of the condensing unit capacity. All zones are each capable of operating separately with individual temperature control.

The Daikin condensing unit shall be interconnected to indoor unit models FXFQ, FXHQ, FXMQ, FXLQ, FXNQ, FXTQ, FXDQ, FXZQ, FXAQ and FXMQ_MF, and shall range in capacity from 7,500 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each

available indoor unit. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.

Operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Manager Controller or a BMS interface.

The RXYQ condensing unit model numbers and the associated number of connectable indoor units per RXYQ condensing unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.
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Model Number	Nominal Capacity (Tons)	Maximum Number of Indoor Units
RXYQ72TTJU	6	12
RXYQ96TTJU	8	16
RXYQ120TTJU	10	20
RXYQ144TTJU	12	25
RXYQ168TTJU	14	29
RXYQ192TTJU	16	33
RXYQ216TTJU	18	37
RXYQ240TTJU	20	41
RXYQ264TTJU	22	45
RXYQ288TTJU	24	49
RXYQ312TTJU	26	54
RXYQ336TTJU	28	58
RXYQ360TTJU	30	62
RXYQ384TTJU	32	64
RXYQ408TTJU	34	64

1.02 VRV IV FEATURES AND BENEFITS

A. Voltage Platform – Heat pump condensing units shall be available with a 208-230V/3/60 power supply.
B. Advanced Zoning – A single system shall provide for up to 64 zones.
C. Independent Control – Each indoor unit shall use a dedicated electronic expansion valve with 2000 positions for independent control.
D. VFD Inverter Control and Variable Refrigerant Temperature – Each condensing unit shall use high efficiency, variable speed all "inverter" compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions
E. Indoor units shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.

F. Configurator software – Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.
G. Autocharging – Each system shall have a refrigerant auto-charging function
H. Flexible Design –
   1. Systems shall be capable of up to 540ft (640ft equivalent) of linear piping between the condensing unit and furthest located indoor unit.
   2. Systems shall be capable of up to 3,280ft total "one-way" piping in the piping network.
   3. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units
   4. Systems shall be capable of up to 295ft from the first REFNET™ / branch point.
   5. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit capacity.
   6. Systems shall be capable of 100ft vertical separation between indoor units.
   7. Condensing units shall be supported with a fan motor ESP up to 0.32" WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
I. Oil Return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle
J. Simple Wiring – Systems shall use 16/18 AWG, 2 wire, multi-stranded, non-shielded and non-polarized daisy chain control wiring.
K. Space Saving – Each system shall have a condensing unit module footprint as small as 36-11/16" x 30-3/16" and no larger than 48-7/8 x 30-3/16
L. Advanced Diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
M. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings
N. Advanced Controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
O. Each system shall be capable of integrating with open protocol BACnet and LonWorks building management systems.
P. Low Sound Levels – Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

1.03 QUALITY ASSURANCE
A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
B. All wiring shall be in accordance with the National Electric Code (NEC).
C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
D. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.
E. The condensing unit will be factory charged with R410A.

1.04 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

Part 3 – PERFORMANCE

3.01 The VRV IV RXYQ_T system shall perform as indicated below.

Model Number	System IEER (seasonal - ducted)	System IEER (seasonal – non-ducted)
RXYQ72TTJU	22.8	26.5
RXYQ96TTJU	22.7	28.0
RXYQ120TTJU	21.4	23.5
RXYQ144TTJU	21.0	24.1
RXYQ168TTJU	19.8	22.1
RXYQ192TTJU	20.7	22.2
RXYQ216TTJU	20.0	20.5
RXYQ240TTJU	18.4	20.8
RXYQ264TTJU	19.3	20.3
RXYQ288TTJU	19.3	20.1
RXYQ312TTJU	18.8	19.9
RXYQ336TTJU	18.5	19.5
RXYQ360TTJU	18.5	19.4
RXYQ384TTJU	18.5	20.4
RXYQ408TTJU	19.0	20.9

Model Number	System EER (full load - ducted)	System EER (full load – non-ducted)
RXYQ72TTJU	13.5	15.0
RXYQ96TTJU	13.0	15.1
RXYQ120TTJU	12.1	13.2
RXYQ144TTJU	11.5	12.3
RXYQ168TTJU	10.6	10.6
RXYQ192TTJU	12.3	11.9
RXYQ216TTJU	11.7	11.6
RXYQ240TTJU	11.6	11.5
RXYQ264TTJU	10.5	10.9
RXYQ288TTJU	10.5	10.5
RXYQ312TTJU	9.8	9.8
RXYQ336TTJU	9.5	9.5
RXYQ360TTJU	10.9	10.3
RXYQ384TTJU	10.0	9.5
RXYQ408TTJU	9.5	9.5

Model Number	System COP@47F (full load - ducted)	System COP@47F (full load – non-ducted)
RXYQ72TTJU	3.58	4.21
RXYQ96TTJU	3.99	4.59
RXYQ120TTJU	3.46	3.79
RXYQ144TTJU	3.72	4.1
RXYQ168TTJU	3.49	3.74
RXYQ192TTJU	3.60	3.8
RXYQ216TTJU	3.65	3.83
RXYQ240TTJU	3.55	3.63
RXYQ264TTJU	3.35	3.33
RXYQ288TTJU	3.31	3.25
RXYQ312TTJU	3.26	3.30
RXYQ336TTJU	3.20	3.22
RXYQ360TTJU	3.25	3.46
RXYQ384TTJU	3.26	3.30
RXYQ408TTJU	3.24	3.24

Model Number	System COP@17F (full load - ducted)	System COP@17F (full load – non-ducted)
RXYQ72TTJU	2.25	2.49
RXYQ96TTJU	2.61	2.86
RXYQ120TTJU	2.58	2.61
RXYQ144TTJU	2.20	2.33
RXYQ168TTJU	2.27	2.34
RXYQ192TTJU	2.40	2.27
RXYQ216TTJU	2.48	2.62
RXYQ240TTJU	2.43	2.62
RXYQ264TTJU	2.30	2.43
RXYQ288TTJU	2.13	2.07
RXYQ312TTJU	2.20	2.32
RXYQ336TTJU	2.27	2.38
RXYQ360TTJU	2.41	2.41
RXYQ384TTJU	2.28	2.28
RXYQ408TTJU	2.10	2.18

Performance Conditions:

Cooling: indoor temp. of 80°F DB, 67°F WB and outdoor temp. of 95°F DB.
Heating: indoor temp. of 70°F DB and outdoor temp. of 47°F DB, 43°F WB.
Equivalent piping length: 25ft

3.02 OPERATING RANGE

The operating range in cooling will be 23°F DB ~ 122°F DB.

The operating range in heating will be 0°F DB – 77°F DB / -4°F WB – 60°F WB.

Cooling mode indoor room temperature range will be 57°F-77°F WB.
Heating mode indoor room temperature range will be 59°F-80°F DB.

3.03 REFRIGERANT PIPING

The system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280 feet of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps or additional components.

REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

3.04 DESIGN BASIS

The HVAC equipment basis of design is Daikin North America. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein (see Key General Specifications Alternate Supplier Checklist). In any event, the contractor shall be responsible for all specified items and intents of this document without further compensation.

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Part 4 – PRODUCTS

4.01 CONDENSING UNIT

A. General: The condensing unit is designed specifically for use with VRV series components.
   1. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator.

Liquid and suction lines must be individually insulated between the condensing and indoor units.

   2. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
   3. The connection ratio of indoor units to condensing unit shall be permitted up to 200%.
   4. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
   5. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input
   6. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
   7. The unit shall incorporate an auto-charging feature to ensure optimum performance. Manual changing should be support with a minimum of 2 hours of system operation data to ensure correct operation

8. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
9. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
10. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
11. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation
12. The condensing unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

B. Unit Cabinet:
1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:
1. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.

Model Number	Fan Motor Output (W) & Quantity
RXYQ72TTJU	750 x 1
RXYQ96TTJU	350 x 2
RXYQ120TTJU	350 x 2
RXYQ144TTJU	750 x 2
RXYQ168TTJU	750 x 2
RXYQ192TTJU	(350 x 2) + (750 x 1)
RXYQ216TTJU	(350 x 2) + (350 x 2)
RXYQ240TTJU	(350 x 2) + (350 x 2)
RXYQ264TTJU	(350 x 2) + (750 x 2)
RXYQ288TTJU	(750 x 2) + (750 x 2)
RXYQ312TTJU	(750 x 2) + (750 x 2)
RXYQ336TTJU	(750 x 2) + (750 x 2)
RXYQ360TTJU	(350 x 2) + (350 x 2) + (350 x 2)
RXYQ384TTJU	(350 x 2) + (350 x 2) + (750 x 2)
RXYQ408TTJU	(350 x 2) + (750 x 2) + (750 x 2)

2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maxi-

mum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 5,544 CFM to 22,283 CFM dependent on model specified

3. Nominal sound pressure levels shall be as shown below.

Model Number	Sound Pressure Level dB(A)
RXYQ72TTJU	58
RXYQ96TTJU	61
RXYQ120TTJU	61
RXYQ144TTJU	64
RXYQ168TTJU	65
RXYQ192TTJU	63
RXYQ216TTJU	64
RXYQ240TTJU	64
RXYQ264TTJU	66
RXYQ288TTJU	67
RXYQ312TTJU	68
RXYQ336TTJU	68
RXYQ360TTJU	66
RXYQ384TTJU	68
RXYQ408TTJU	68

4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
6. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

D. Condenser Coil:
1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins are to be covered with an anti-corrosion Ulta Gold coating as standard with a salt spray test rating of 1000hr(ASTM B117), Acetic acid salt spray test: 500hr(ASTM G85)
5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention.

E. Compressor:
1. The Daikin inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in to-

tal cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. The target suction pressure should be capable of automatic reset based on outdoor temperature and system load to improve efficiency. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.

2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "G-type" or "J-type".
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 10% to 100%.
5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
6. Oil separators shall be standard with the equipment together with an intelligent oil management system.
7. The compressor shall be spring mounted to avoid the transmission of vibration eliminating the standard need for spring insolation
8. Compressor configurations

Tonnage	Number of Compressors	Compressor Types
6	1	Inverter controlled
8	1	Inverter controlled
10	1	Inverter controlled
12	2	All inverter controlled
14	2	All inverter controlled
16	2	All inverter controlled
18	2	All inverter controlled
20	2	All inverter controlled
22	3	All inverter controlled
24	4	All inverter controlled
26	4	All inverter controlled
28	4	All inverter controlled
30	3	All inverter controlled
32	4	All inverter controlled
34	5	All inverter controlled

9. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition for single module and manifolded systems.

1. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring

sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network

F. Electrical:

1. The power supply to the condensing unit shall be 208-230 volts, 3 phase, 60 hertz +/- 10%.

Power Supply Voltage	Voltage Range
208-230V/3/60	187V-253V

Model	MCA	MOP	Compressor RLA
RXYQ72TTJU	27.6	35	15.7
RXYQ96TTJU	36.3	45	23.8
RXYQ120TTJU	36.3	45	26.2
RXYQ144TTJU	55.1	60	16.7+16.7
RXYQ168TTJU	55.1	60	18.8+18.8
RXYQ192TTJU	27.6 + 36.3	35+45	15.7+26.2
RXYQ216TTJU	36.3 + 36.3	45+45	23.8+26.2
RXYQ240TTJU	36.3 + 36.3	45+45	26.2+26.2
RXYQ264TTJU	36.3 + 55.1	45+60	26.2+16.7+16.7
RXYQ288TTJU	55.1 + 55.1	60+60	(16.7+16.7) x 2
RXYQ312TTJU	55.1 + 55.41	60+60	16.7+16.7+18.8+18.8
RXYQ336TTJU	55.1 + 55.1	60+60	(18.8+18.8) x 2
RXYQ360TTJU	36.3 + 36.3 + 36.3	45+45+45	26.2+26.2+26.2
RXYQ384TTJU	36.3 + 36.3 + 55.1	45+45+60	23.8+26.2+18.8+18.8
RXYQ408TTJU	36.3 + 55.2 + 55.1	45+60+60	23.8+16.7+16.7+18.8+18.8

2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation
4. The control wiring maximum lengths shall be as shown below.

	Condenser to Indoor Unit	Condenser to Central Controller	Indoor Unit to Remote Control
Control Wiring Length	6,665 ft	3,330 ft	1,665 ft
Wire Type	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

4.02 VRV INDOOR UNITS

* INSERT INDOOR UNITS AS REQUIRED

Part 5 - HVAC EQUIPMENT ALTERNATE (GENERAL INFORMATION)

5.01 The alternate equipment supplier shall provide to the bidding mechanical contractor a complete equipment data package. This package shall include, but is not limited to, equipment capacities at the

design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.

The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.

The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufactures product may not be acceptable or approved.

5.02 The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation. The drawing format shall be .dxf or equivalent, on 30"x42" sheets. The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings. The alternate equipment supplier shall prepare the following drawings:

XXX HVAC Floor Plan
XXX HVAC Refrigerant Piping Plan
XXX HVAC Refrigerant Piping/Controls Details
XXX HVAC Details
XXX HVAC Schedules

The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.

Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.

The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.

5.03 The equipment supplier shall submit as part of the equipment data package condensing unit data sheets. Data sheets to include the following:

Capacities at project design conditions: Cooling
Cooling (Btu/h)

Cooling Input Power – ducted (kW)
Cooling Input Power – ductless (kW)
Cooling Input Power – mixed (kW)

Part Load IEER – ducted
Part Load IEER – ductless
Part Load IEER - mixed

Full Load EER – ducted

Full Load EER – ductless
Full Load EER - mixed

Capacities at project design conditions: Heating
Heating (Btu/h)

Heating Input Power – ducted (kW)
Heating Input Power – ductless (kW)
Heating Input Power – mixed (kW)

Full Load COP@47F – ducted
Full Load COP@47F – ductless
Full Load COP@47F – mixed

Full Load COP@17F – ducted
Full Load COP@17F – ductless
Full Load COP@17F – mixed

The submitted capacity and efficiency performance must meet or exceed the listed performance on the schedule at the designed space conditions including de-rate factors for defrost if applicable and refrigerant piping losses.

Operating Temperature Range:
Cooling
Heating

Power Supply:
Maximum Circuit Amps (MCA)
Maximum Overcurrent Protection Amps (MOP)
Maximum Starting Current (MSC)
Condenser Fan Motor

Refrigerant:
Refrigerant Type and Charge details including field charge for piping to ensure code compliance
Control of refrigerant temperatures based on weather and load or alterative function

Unit Data:
Max. Number of Indoor Units
Sound Pressure Level at 3ft. (dBA)
Weight (lbs)
Dimensions
Demand limit function description
Details on sequential start functionality
Coil anticorrosion data

5.04 The equipment supplier shall guarantee the performance of their system and all published data submitted. Performance shall be based on the design criteria below.

Room Temperature (Cooling): _____
Room Temperature (Heating): _____
Ambient Temperature (Summer): _____
Ambient Temperature (Winter): _____
Defrost De-rate Factor: _____
Refrigerant Piping Loss: _____

5.05 The alternate equipment supplier shall submit with bid, indoor unit data sheets. Data sheets to include the following:

Capacities at project design conditions:
Cooling (Btu/h)
Cooling Input Power (kW)
Part Load IEER
Full Load EER
Heating (Btu/h)
Heating Input Power (kW)
Full Load COP@47F
Full Load COP@17F
Air Flow (CFM)

External Static Pressure (ESP)
Electrical Data (MCA, MOP, MSC, RLA)
Weight (lbs)
Dimensions

END OF SECTION 239100

SECTION 239110 – VARIABLE REFRIGERANT FLOW FAN COIL UNITS

Daikin North America LLC

HVAC Guide Specifications
Multiple Evaporator, Direct Expansion (DX), Air-Cooled, Variable Capacity, Split System

Size Range:
0.6 to 8 Tons Nominal

Daikin AC Model Number:

FXFQ_T INDOOR UNIT – ROUND FLOW SENSING CEILING CASSETTE UNIT
FXZQ INDOOR UNIT – 4 WAY CEILING CASSETTE UNIT (2'x2')
FXMQ_M INDOOR UNIT – CONCEALED CEILING DUCTED UNIT (Med. Static)

FXMQ_PA INDOOR UNIT – CONCEALED CEILING DUCTED UNIT (Med. Static)
FXDQ INDOOR UNIT – SLIM DUCT CONCEALED CEILING UNIT
FXHQ INDOOR UNIT – CEILING SUSPENDED CASSETTE UNIT
FXAQ INDOOR UNIT – WALL MOUNTED UNIT
FXLQ INDOOR UNIT – FLOOR CONSOLE UNIT
FXNQ INDOOR UNIT – FLOOR CONSOLE CONCEALED UNIT
FXTQ INDOOR UNIT – VERTICAL AIR HANDLING UNIT
FXMQ_MF INDOOR UNIT – OUTSIDE AIR PROCESSING UNIT

Part 1 – GENERAL

VARIABLE REFRIGERANT VOLUME (VRV / VRV-S) AIR CONDITIONING
SPECIFICATION – Heat Recovery/Heat Pump Indoor Units

1.01 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) – Heating and Cooling Equipment and bear the Listed Mark.
B. All wiring shall be in accordance with the National Electric Code (NEC)/Canadian Electrical Code (CEC).
C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
D. The outdoor unit will be factory charged with R-410A.

1.02 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

Part 3 – PERFORMANCE

3.01 DESIGN BASIS

The HVAC equipment basis of design is Daikin. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein (see Key General Specifications Alternate Supplier Checklist). In any event the contractor shall be responsible for all specified items and intents of this document without further compensation.

Part 4 – PRODUCTS

2.01 FXFQ_T – ROUND FLOW SENSING CEILING CASSETTE UNIT

A. General: Daikin indoor unit model FXFQ_T shall be a round flow ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. Model numbers are FXFQ07TVJU, FXFQ09TVJU, FXFQ12TVJU, FXFQ15TVJU , FXFQ18TVJU, FXFQ24TVJU, FXFQ30TVJU, FXFQ36TVJU, FXFQ48TVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel. The supply air is distributed via four individually motorized louvers. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72, BRC2A71 and BRC1E52B7. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXFQ07TVJU	7,500	8,500
FXFQ09TVJU	9,500	10,500
FXFQ12TVJU	12,000	13,500
FXFQ15TVJU	15,000	16,500
FXFQ18TVJU	18,000	20,000
FXFQ24TVJU	24,000	27,000
FXFQ30TVJU	30,000	34,000
FXFQ36TVJU	36,000	40,000
FXFQ48TVJU	48,000	54,000

C. Indoor Unit:
1. The Daikin indoor unit FXFQ_T shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The round flow supply air flow can be field modified to 23 different airflow patterns to accommodate various installation configurations including corner installations.
5. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
6. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2" of lift from bottom of unit to top of drain piping and has a built in safety shutoff and alarm.
7. The indoor units shall be equipped with a return air thermistor.
8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
9. The voltage range will be 253 volts maximum and 187 volts minimum.
10. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.
11. Supplied air shall be directed automatically by four individually controlled louvers.

D. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
2. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
3. The airflow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.
4. Fresh air intake shall be possible by way of Daikin's optional fresh air intake kit.

5. A branch duct knockout shall exist for branch ducting of supply air.
6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
7. Optional high efficiency air filters are available for each model unit.

E. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.
3. The airflow rate shall be available in three manual settings.
4. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.
6. The fan motor shall be thermally protected.

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.
2. Optional high efficiency disposable air filters shall be available.
3. Optional Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.
5. A condensate pan with antibacterial treatment shall be located under the coil.
6. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

4. For the Sensing functions and the optional Self-Cleaning Filter functions, Remote controller BRC1E52B7 shall be used. Consult with Daikin prior to applying controls.

J. Optional Accessories Available:
   1. A high efficiency disposable air filter kit.
   2. Air intake kit .
   3. Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.
   4. Remote "in-room" sensor kit (KRCS01-4B).
      i. The Daikin wall mounted, hard wired remote sensor kit is recommended for when a NAV controller is not used or when the NAV controller is not located in the space that is being controlled. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

4.02 FXZQ – 4 WAY CEILING CASSETTE UNIT (2'x2')

A. General: Daikin indoor unit model FXZQ shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 18,000 Btu/h. Model numbers are FXZQ07MVJU9, FXZQ09MVJU9, FXZQ12MVJU9, FXZQ15MVJU9, FXZQ18MVJU9 to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a four-way air distribution type, white (RAL9010), impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. The indoor units sound pressure shall range from 29 dB(A) to 34 dB(A) at low speed measured at 5 feet below the unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXZQ07MVJU9	7,500	8,700
FXZQ09MVJU9	9,500	11,100
FXZQ12MVJU9	12,000	14,000
FXZQ15MVJU9	15000	17,500
FXZQ18MVJU9	18,000	21,000

C. Indoor Unit:
   1. The Daikin indoor unit FXZQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
   2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   3. Both refrigerant lines shall be insulated from the outdoor unit.
   4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
   5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
   6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21” of lift and has a built in safety shutoff and alarm.
   7. The indoor units shall be equipped with a return air thermistor.
   8. All electrical components are reached through the decoration panel, which reduces the required side service access.
   9. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
   10. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
   1. The cabinet shall be space saving and shall be located into the ceiling.
   2. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
   3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
   4. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
   5. A branch duct knockout shall exist for branch ducting supply air.
   6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be direct-drive turbo fan type with statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.06 to 0.12 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 17 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with a 21 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

J. Optional Accessories Available:
1. Direct fresh air intake kit (KDDQ44X60).
2. Supply air duct connections.
3. Remote “in-room” sensor kit (KRCS01-1B).
    i. The Daikin wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

4.03 FXMQ_M – CONCEALED CEILING DUCTED UNIT (Med. Static)

A. General: Daikin indoor unit FXMQ_M shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 72,000 Btu/h to 96,000 Btu/h. Model numbers are FXMQ72MVJU and FXMQ96MVJU to be connected to outdoor unit model RXYQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. The indoor units sound pressure shall be 48 dB(A) at low speed measured 5 feet below the ducted unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXMQ72MVJU	72,000	96,000
FXMQ96MVJU	96,000	108,000

C. Indoor Unit:
   1. The Daikin indoor unit FXMQ_M shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an adjustable external static pressure switch.
   2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   3. Both refrigerant lines shall be insulated from the outdoor unit.
   4. The indoor units shall be equipped with a return air thermistor.
   5. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
   6. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
   1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
   2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
   1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
   2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.

3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
6. Fan motor external static pressure for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ72MVJU	0.95 – 0.72
FXMQ96MVJU	0.95 – 0.8

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

I. Optional Accessories Available:
1. Remote “in-room” sensor kit KRCS01-1B (recommended).
   i. The Daikin wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

4.04 FXMQ_PA - CONCEALED CEILING DUCTED UNIT (Med. Static)

A. General: Daikin indoor unit FXMQ_PA shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. Model numbers are FXMQ07PAVJU, FXMQ09PAVJU, FXMQ12PAVJU, FXMQ15PAVJU, FXMQ18PAVJU, FXMQ24PAVJU, FXMQ30PAVJU, FXMQ36PAVJU, FXMQ48PAVJU, and FXMQ54PAVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8" from the drain pipe opening. The indoor units sound pressure shall range from 29 dB(A) to 43 dB(A) at low speed measured 5 feet below the ducted unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXMQ07PAVJU	7,500	8,500
FXMQ09PAVJU	9,500	10.500
FXMQ12PAVJU	12,000	13,500
FXMQ15PAVJU	15,000	16,500
FXMQ18PAVJU	18,000	20,000
FXMQ24PAVJU	24,000	27,000
FXMQ30PAVJU	30,000	34,000
FXMQ36PAVJU	36,000	40,000
FXMQ48PAVJU	48,000	54,000
FXMQ54PAVJU	54,000	60,000

C. Indoor Unit:

1. The Daikin indoor unit FXMQ_PA shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay,

and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8” of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
5. The indoor units shall be equipped with a return air thermistor.
6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
7. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
4. The airflow rate shall be available in three settings.
5. The fan motor shall be thermally protected.
6. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
7. Fan motor external static pressure range for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ07PAVJU	0.40 – 0.12
FXMQ09PAVJU	0.40 – 0.12
FXMQ12PAVJU	0.40 – 0.12
FXMQ15PAVJU	0.80 – 0.20
FXMQ18PAVJU	0.80 – 0.20
FXMQ24PAVJU	0.80 – 0.20
FXMQ30PAVJU	0.80 – 0.20
FXMQ36PAVJU	0.80 – 0.20
FXMQ48PAVJU	0.80 – 0.20
FXMQ54PAVJU	0.56 – 0.20

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4” outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with an 18-3/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

I. Optional Accessories Available:
1. Remote “in-room” sensor kit KRCS01-4B (recommended).
    1. The Daikin wall mounted, hard wired remote sensor kit is recommended for when a NAV controller is not used or when the NAV controller is not located in the space that is being controlled. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).
2. MERV 13 Filter kit. Can be configured for right or left access. Filters replaceable without tools.
3. Air side Economizer designed for connection to the rear of FXMQ30-54PAVJU.

4.05 FXDQ – SLIM DUCT CONCEALED CEILING UNIT

A. General: Daikin indoor unit model FXDQ shall be a Slim, built-in ceiling concealed fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing. It shall be available in capacities from 7,000 Btu/h to 24,000 Btu/h. Model numbers are FXDQ07MVJU, FXDQ09MVJU, FXDQ12MVJU, FXDQ18MVJU, and FXDQ24MVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air or bottom return air configuration. All models feature a very low height (7-7/8") making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting

changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. Included as standard equipment, a long-life filter that is mold resistant and a condensate drain pan and drain pump kit that pumps to 23-5/8" from the drain pipe opening. The indoor units sound pressure level shall range from 29 dB(A) to 32 dB(A) at low speed and 33 dB(A) to 36 dB(A) at high speed 5 feet below the suction grille.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXDQ07MVJU	7,500	8,500
FXDQ09MVJU	9,500	10,500
FXDQ12MVJU	12,000	13,500
FXDQ18MVJU	18,000	20,000
FXDQ24MVJU	24,000	27,000

C. Indoor Unit:
1. The Daikin indoor unit FXDQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have adjustable external static pressure capabilities.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 23-5/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.
9. Switch box shall be reached from the side or bottom for ease of service and maintenance.

D. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 62W to 130W.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
6. Fan motor external static pressure range for nominal airflow:

Model Number	Fan ESP (in. WG)
FXDQ07MVJU	0.12 - 0.04
FXDQ09MVJU	0.12 – 0.04
FXDQ12MVJU	0.12 – 0.04
FXDQ18MVJU	0.17 – 0.06
FXDQ24MVJU	0.17 – 0.06

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2 or 3-row cross fin copper evaporator coil with 14 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/32” outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with a 23-5/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

J. Optional Accessories Available:
   1. Remote “in-room” sensor kit KRCS01-1B (recommended).
      i. The Daikin wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

4.06 FXHQ – CEILING SUSPENDED CASSETTE UNIT

A. General: Daikin indoor unit FXHQ shall be a ceiling suspended fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall or ceiling within a conditioned space. This compact design with finished white casing shall be available in capacities from 12,000 Btu/h to 36,000 Btu/h. Model numbers are FXHQ12MVJU, FXHQ24MVJU and FXHQ36MVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 32 dB(A) to 38 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Each unit’s performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXHQ12MVJU	12,000	13,500
FXHQ24MVJU	24,000	27,000
FXHQ36MVJU	36,000	40,000

C. Indoor Unit:
   1. The Daikin indoor unit FXHQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from the rear, top or left and right sides of the unit.

2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. The indoor units shall be equipped with a condensate pan.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be affixed to a factory supplied wall/ceiling hanging brackets and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 62W to 130W.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 15 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.
6. A condensate pan shall be located in the unit.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

I. Optional Accessories Available:
   1. Remote “in-room” sensor kit KRCS01-1B.
   2. A condensate pump (DACA-CP3-1).

4.07 FXAQ – WALL MOUNTED UNIT

A. General: Daikin indoor unit FXAQ shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. This compact design with finished white casing shall be available in capacities from 7,500 Btu/h to 24,000 Btu/h. Model numbers are FXAQ07PVJU, FXAQ09PVJU, FXAQ12PVJU, FXAQ18PVJU and FXAQ24PVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 31 dB(A) to 41 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Each unit’s performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXAQ07PVJU	7,500	8,500
FXAQ09PVJU	9,500	10,500
FXAQ12PVJU	12,000	13,500
FXAQ18PVJU	18,000	20,000
FXAQ24PVJU	24,000	26,500

C. Indoor Unit:
   1. The Daikin indoor unit FXAQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from either left or right sides.
   2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
   3. Both refrigerant lines shall be insulated from the outdoor unit.
   4. Return air shall be through a resin net mold resistant filter.

5. The indoor units shall be equipped with a condensate pan.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.054 to 0.058 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 11/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.
6. A condensate pan shall be located in the unit.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

I. Optional Accessories Available:
1. Remote “in-room” sensor kit KRCS01-1B.
2. A condensate pump (DACA-CP3-1).

4.08 FXLQ – FLOOR CONSOLE UNIT

A. General: Daikin indoor unit FXLQ shall be a floor or low wall mounted console fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation within a conditioned space. It shall have a top discharge air grill and resin net mold resistant filtered bottom return air. This compact design with finished ivory white casing shall be available in capacities from 12,000 Btu/h to 24,000 Btu/h. Model numbers are FXLQ12MVJU9, FXLQ18MVJU9 and FXLQ24MVJU9 to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. The cabinets can be mounted on the floor with refrigerant and condensate lines directed downward or affixed to the wall with horizontal refrigerant and condensate knockouts. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. A mold-resistant, resin net air filter shall be included as standard equipment. The indoor units sound pressure shall range from 35 dB(A) to 40 dB(A) at high speed measured at 5 feet away and 5 feet high.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXLQ12MVJU9	12,000	13,500
FXLQ18MVJU9	18,000	20,000
FXLQ24MVJU9	24,000	27,000

C. Indoor Unit:

1. The Daikin indoor unit FXLQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. Condensate draining shall be made via gravity or external condensate pump.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing fiberglass urethane foam insulation.
3. Maintenance access shall be a minimum of ¾ inch in the rear, 4 inches on the right and left sides.

E. Fan:
1. The fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.034 to 0.047 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3-row cross fin copper evaporator coil with 17 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 27/32 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

J. Optional Accessories Available:
1. Remote “in-room” sensor kit KRCS01-1B.

4.09 FXNQ – FLOOR CONSOLE CONCEALED UNIT

A. General: Daikin indoor unit FXNQ shall be a floor or wall mounted console fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation within a conditioned space. It shall have a top discharge air grill and filtered bottom return air. This compact design unfinished casing shall be available in capacities from 12,000 Btu/h to 24,000 Btu/h. Model numbers are FXNQ12MVJU9, FXNQ18MVJU9 and FXNQ24MVJU9 to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. The cabinets can be mounted on the floor with refrigerant and condensate lines directed downward or affixed to the wall with horizontal refrigerant and condensate knockouts. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71. A mold-resistant, resin net air filter shall be included as standard equipment. The indoor units sound pressure shall range from 35 dB(A) to 40 dB(A) at high speed measured at 5 feet away and 5 feet high.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXNQ12MVJU9	12,000	13,500
FXNQ18MVJU9	18,000	20,000
FXNQ24MVJU9	24,000	27,000

C. Indoor Unit:

1. The Daikin indoor unit FXNQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. Condensate draining shall be made via gravity or external condensate pump.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing fiberglass urethane foam insulation.
3. Maintenance access shall be a minimum of ¾ inch in the rear, 4 inches on the right and left sides.

E. Fan:
1. The fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.034 to 0.047 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3-row cross fin copper evaporator coil with 17 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 27/32 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

J. Optional Accessories Available:
1. Remote “in-room” sensor kit KRCS01-1B.
2. A condensate pump (DACA-CP3-1).

4.10 FXTQ – VERTICAL AIR HANDLING UNIT

A. General: Daikin indoor unit FXTQ_PA shall be a floor mounted vertical or horizontal right air handling unit, operable with refrigerant R-410A, equipped with an electronic expansion valve and direct-drive ECM type fan with auto CFM adjustment, for installation within a conditioned space. When installed in a vertical configuration it shall have top discharge air and bottom return air. When installed in a horizontal right configuration it shall have a horizontal discharge air and horizontal return air. This compact design with pre-painted heavy-gauge steel casing shall be available in capacities from 12,000 Btu/h to 54,000 Btu/h. Model numbers are FXTQ12PAVJU, FXTQ18PAVJU, FXTQ24PAVJU, FXTQ30PAVJU, FXTQ36PAVJU, FXTQ42PAVJU, FXTQ48PAVJU and FXTQ54PAVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. A KRCS01-4B remote temperature sensor kit shall be required for all FXTQ indoor units not utilizing the thermistor in the Daikin remote controller BRC1E72. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72 and BRC2A71.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	**Cooling** (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	**Heating** (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXTQ12PAVJU	12,000	13,500
FXTQ18PAVJU	18,000	20,000
FXTQ24PAVJU	24,000	27,000
FXTQ30PAVJU	30,000	34,000
FXTQ36PAVJU	36,000	40,000
FXTQ42PAVJU	42,000	47,000
FXTQ48PAVJU	48,000	54,000
FXTQ54PAVJU	54,000	60,000

C. Indoor Unit:

1. The Daikin indoor unit FXTQ_PA components shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, brazed connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through an optional or field supplied filter.
5. Condensate draining shall be made via gravity or external condensate pump.
6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

7. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be constructed with sound absorbing, foil-faced insulation to control air leakage.
2. Select an installation location with adequate structural support, space for service access and clearance for air return and supply duct connections.
3. A field supplied secondary drain pan must be installed

E. Fan:
1. The fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.2 to 0.5 HP.
3. The airflow rate shall be available in high setting.
4. The fan motor shall be thermally protected.
5. Fan motor external static pressure for nominal airflow:

Model Number	Fan ESP (in. WG)
FXTQ12PAVJU	Up to 0.5
FXTQ18PAVJU	Up to 0.5
FXTQ24PAVJU	Up to 0.5
FXTQ30PAVJU	Up to 0.5
FXTQ36PAVJU	Up to 0.5
FXTQ42PAVJU	Up to 0.5
FXTQ48PAVJU	Up to 0.5
FXTQ54PAVJU	Up to 0.5

F. Filter:
1. The return air shall be filtered by means of a field supplied filter.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 4-row cross fin copper evaporator coil with 15 fpi design completely factory tested.
4. The refrigerant connections shall be brazed connections and the condensate will be 3/4 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

J. Optional Accessories Available:
1. Field installed 3-20kW electric heaters (HKR-03, HKR-05C, HKR-06, HKR-08C, HKR-10C). The indoor units shall have circuit breakers supplied with each electric heat kit.
2. Air filter (FIL 36-42, FIL 48-61).
3. Insulation kit for vertical (DPI 36-42/20, DPI 48-61/20) and horizontal (DPIH 36-42, DPIH 48-61) configurations.
4. BRC4C84 wireless controller.

4.11 FXMQ_MF – OUTSIDE AIR PROCESSING UNIT

A. General: Daikin indoor unit FXMQ_MF shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. The unit shall be capable of introducing up to 100% outside air controlled to a fixed discharge air temperature. It is constructed of a galvanized steel casing. It shall be available in capacities from 48,000 Btu/h to 96,000 Btu/h. Model numbers are FXMQ48MFVJU, FXMQ72MFVJU and FXMQ96MVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ heat pump and REYQ / RWEYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The indoor units sound pressure shall range from 42 dB(A) to 47 dB(A) at low speed measured 5 feet below the ducted unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

C. Indoor Unit:
1. The Daikin indoor unit FXMQ_MF shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connec-

Model Number	**Cooling** (Outdoor 91°F DB / 82°F WB, Discharge 64°F DB, 25 ft pipe length)	**Heating** (Outdoor 32°F DB / 27°F WB, Discharge 77°F DB, 25 ft pipe length)
FXMQ48MFVJU	48,000	30,000
FXMQ72MFVJU	72,000	47,000
FXMQ96MFVJU	96,000	59,000

tions, self-diagnostics, auto-restart function, 3-minute fused time delay and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The indoor units shall be equipped with a discharge air thermistor.

5. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
6. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.
3. The fan motor shall be thermally protected.
4. Fan motor external static pressure for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ48MFVJU	0.88
FXMQ72MFVJU	0.96
FXMQ96MFVJU	1.03

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

Part 5 - HVAC EQUIPMENT ALTERNATE (GENERAL INFORMATION)

5.01 The alternate equipment supplier shall provide to the bidding mechanical contractor a complete equipment data package. This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.

The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.

The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufactures product may not be acceptable or approved.

5.02 The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation. The drawing format shall be .dxf or equivalent, on 30"x42" sheets. The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings. The alternate equipment supplier shall prepare the following drawings:

XXX HVAC Floor Plan
XXX HVAC Refrigerant Piping Plan
XXX HVAC Refrigerant Piping/Controls Details
XXX HVAC Details
XXX HVAC Schedules

The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.

Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.

The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.

5.03 The equipment supplier shall submit as part of the equipment data package outdoor unit data sheets. Data sheets to include the following:

Capacities at project design conditions: Cooling
Cooling (Btu/h)

Cooling Input Power
(kW)

Capacities at project design conditions: Heating
Heating (Btu/h)

Heating Input Power
(kW)

The submitted capacity and efficiency performance must meet or exceed the listed performance on the schedule at the designed outdoor ambient, and indoor space temperature conditions including de-rate factors for defrost and refrigerant piping lengths.

Operating Temperature Range:
Cooling
Heating

Power Supply:
Maximum Circuit Amps (MCA)
Maximum Overcurrent Protection Amps (MOP)
Maximum Starting Current (MSC)
Outdoor Fan Motor

Refrigerant:
Refrigerant Type/Charge
Control

Unit Data:
Max. Number of Indoor Units
Sound Pressure Level at 3ft. (dBA)
Weight (lbs)
Dimensions

5.04 The equipment supplier shall guarantee the performance of their system and all published data submitted. Performance shall be based on the design criteria below.

Room Temperature (Cooling): _____
Room Temperature (Heating): _____
Ambient Temperature (Summer): _____
Ambient Temperature (Winter): _____
Defrost De-rate Factor: _____
Refrigerant Piping Loss in cooling (correction factor): _____
Refrigerant Piping Loss in heating (correction factor): _____

5.05 The alternate equipment supplier shall submit with bid, indoor unit data sheets. Data sheets to include the following:

Capacities:
Cooling (Btu/h)
Heating (Btu/h)
Air Flow (CFM)

External Static Pressure (ESP)

Electrical Data (MCA, MOP, MSC)
Weight (lbs)
Dimensions

END OF SECTION 239110

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Type THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MC and Type SO with ground wire.

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:

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC or Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. 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 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. 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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm).

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

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."

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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. UTP cabling.
2. RS-232 cabling.
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 5e cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements:

1. Belden CDT Inc.; Electronics Division.
2. 3M.
3. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, Plenum Rated: Type CMP or Type MPP, complying with NFPA 262.
    b. Communications, Riser Rated: Type CMR; or Type MPP, Type CMP, or Type MPR; complying with UL 1666.
    c. Multipurpose: Type MP or Type MPG.
    d. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    e. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements:

1. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Panduit Corp.
4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110 style for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.5 RS-232 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.

5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.9 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements:

1. Brady Corporation.
2. Kroy LLC.
3. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
2. Secure conduits to backboard if entering room from overhead.
3. Extend conduits 3 inches (75 mm) above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding 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. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.5 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 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 Grounding Conductor:

1. No. 4 AWG minimum, soft-drawn copper.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, 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.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

C. 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 Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. 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.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

C. Concrete 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. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. 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.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

3.4 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. 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.

1.5 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. 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:
   a. Cooper B-Line, Inc.; a division of Cooper Industries.
   b. ERICO International Corporation.
   c. Thomas & Betts Corporation.
   d. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer's standard painted coating 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 and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Hilti Inc.
3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
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.

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 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Steel: Spring-tension clamps.
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Division 27 Section "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
2. Division 28 Section "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways, nonmetallic wireways and surface raceways and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Electri-Flex Company.
4. O-Z/Gedney; a brand of EGS Electrical Group.

5. Republic Conduit.
6. Robroy Industries.
7. Southwire Company.
8. Thomas & Betts Corporation.
9. Western Tube and Conduit Corporation.
10. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel or die cast.
b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. CANTEX Inc.
3. CertainTeed Corp.
4. Condux International, Inc.
5. Electri-Flex Company.
6. RACO; a Hubbell company.
7. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.

2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R as required, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

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. Allied Moulded Products, Inc.
2. Hoffman; a Pentair company.
3. Lamson & Sessions; Carlon Electrical Products.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Hoffman; a Pentair company.
5. Hubbell Incorporated; Killark Division.
6. Mono-Systems, Inc.
7. O-Z/Gedney; a brand of EGS Electrical Group.
8. RACO; a Hubbell Company.
9. Robroy Industries.
10. Spring City Electrical Manufacturing Company.
11. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
12. Thomas & Betts Corporation.
13. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R as required 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: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1 or Type 3R as required 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation; Hubbell Power Systems.
    d. Oldcastle Precast, Inc.; Christy Concrete Products.
    e. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation; Hubbell Power Systems.
    d. Nordic Fiberglass, Inc.
    e. Oldcastle Precast, Inc.; Christy Concrete Products.
    f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Green.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC.".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below 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: GRC. Raceway locations include the following:

    a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    b. Mechanical rooms.
    c. Gymnasiums.

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.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-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. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

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. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. A. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. 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. Secure raceways to reinforcement at maximum10-foot (3-m) intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, 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.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. 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."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 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 enclosure.

E. Field-cut openings for 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 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

B. FIRESTOPPING

C. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Grout.
3. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of 450 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. 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."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. 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.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

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.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

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 and system or service type.

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. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

G. 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.

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 and system or service type.

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. 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.

D. 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. 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.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 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. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type ID:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

D. Tag: Type IID:

1. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
2. Overall Thickness: 8 mils (0.2 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 300 lbf (1334 N), and 12,500 psi (86.1 MPa).

2.6 EQUIPMENT IDENTIFICATION LABELS

A. 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).

B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. 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. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. 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.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Enclosed switches.
d. Enclosed circuit breakers.
e. Contactors.
f. Remote-controlled switches, dimmer modules, and control devices.
g. Power-generating units.

END OF SECTION 260553

SECTION 260800 – ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes Division 16 responsibilities in the commissioning process.

1.3 COMMISSIONING AGENCY

A. The commissioning agency (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. Commissioning involves all parties to the design and construction process, including the mechanical Division 16 contractor, and all specialty sub-contractors within Division 16.

1.4 CONTRACTOR RESPONSIBILITY

A. The electrical Division 16 contractor's responsibilities are defined in Section 01810 of the specifications. These responsibilities apply to all specialty sub-contractors and major equipment suppliers within Division 16. Each contractor and supplier shall review Section 01810.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMISSIONED SYSTEMS

A. A list of systems to be commissioned on this job shall include but not be limited to the following.
   1. Lighting
   2. Lighting Control
   3. Systems commissioned under 15995 and 15996

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relays.

B. Related Requirements:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

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. Intermatic, Inc.
2. Leviton Mfg. Company Inc.
3. NSi Industries LLC; TORK Products.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holiday.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

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. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR OCCUPANCY SENSORS

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. Hubbell Building Automation, Inc.
2. Leviton Mfg. Company Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Square D; a brand of Schneider Electric.
6. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.4 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
4. Square D; a brand of Schneider Electric.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.5 EMERGENCY SHUNT RELAY

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. Lighting Control and Design; Acuity Lighting Group, Inc.
2. Watt Stopper.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Division 26 Section "Network Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices 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 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

3. Finishes:

   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

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.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

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.

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 PANELBOARD SUPPRESSORS

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. Current Technology; a subsidiary of Danahar Corporation.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Liebert Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D; a brand of Schneider Electric.

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

a. Fuses rated at 200-kA interrupting capacity.

b. Integral disconnect switch.
c. Redundant replaceable modules.
d. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
e. LED indicator lights for power and protection status.
f. Audible alarm, with silencing switch, to indicate when protection has failed.
g. Four-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

   a. Line to Neutral: 70,000 A.
   b. Line to Ground: 70,000 A.
   c. Neutral to Ground: 50,000 A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:

   a. Line to Neutral: 400 V for 208Y/120.
   b. Line to Ground: 400 V for 208Y/120.
   c. Neutral to Ground: 400 V for 208Y/120.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. 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.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate 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."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

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 equipment for electricity metering by utility company.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.6 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    c. Siemens Energy & Automation, Inc.
    d. Square D; a brand of Schneider Electric.

2. Comply with requirements of utility company for meter center.
3. Housing: NEMA 250, Type 3R enclosure.
4. Minimum Short-Circuit Rating: 42,000 A symmetrical at rated voltage.

    a. Identification: Complying with requirements in Division 26 Section "Identification for Electrical Systems" with legend identifying tenant's address.
    b. Physical Protection: Tamper resistant, with hasp for padlock.

5. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
6. Surge Protection: For main disconnect device, comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Wall-box motion sensors.
4. Snap switches and wall-box dimmers.
5. Communications outlets.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

C. UTP: Unshielded twisted pair.

1.4 ACTION 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.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.7 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

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).
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:

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, non-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:

   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, 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:

   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-30P and L5-30R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 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:

   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
   c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.8 OCCUPANCY SENSORS

A. Long-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:

   a. Hubbell; ATD1600WRP.
   b. Leviton; ODW12-MRW.
   c. Watt Stopper (The); DT-200.

2. 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).

2.9 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:

   a. Cooper; 3560-6.
   b. Leviton; 40649.

2. 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.

2.10 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: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic 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 thermoplastic with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Service Plate: Rectangular, solid brass with satin finish.

C. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

2.12 POKE-THROUGH ASSEMBLIES

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. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
2. Size: Selected to fit nominal 3-inch (75-mm) cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 3-inch (75-mm) cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.13 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

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.
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. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 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 black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits and enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses 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. Ambient temperature adjustment information.
2. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.6 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Motor Branch Circuits: Class RK1, time delay.
2. Other Branch Circuits: Class RK1, time delay
3. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products 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.

B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products 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.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.

B. Related Sections include the following:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. 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.

E. Comply with ASME B15.1.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 40 deg C.
2. Altitude: Sea level to 1000 feet (300 m).

1.9 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 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: 5 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

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. Generac Power Systems, Inc.
2. Kohler Co.; Generator Division.
3. 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.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

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. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Residential 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 18 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 95 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 12-V 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 Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

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 100 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. Operation of a remote emergency-stop switch also shuts down generator set.

B. 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.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 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 high-level shutdown of fuel supply alarm.

D. 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.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."

F. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

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.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

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.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

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: Dripproof.

G. 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.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 restrained spring isolators 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 Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."

E. 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 Section 232116 Hydronic Piping Specialties."

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 232116 Hydronic Piping Specialties."

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.5 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. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) 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.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. 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.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 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 terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 017900 "Demonstration and Training."

B. Upon completion of generator testing, the contractor shall be responsible to provide fuel for the generator fuel tank to max capacity of the tank.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciation and control systems.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product 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. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches and remote annunciator and control panels through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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. Contactor Transfer Switches:

    a. Caterpillar; Engine Div.
    b. Emerson; ASCO Power Technologies, LP.
    c. GE Zenith Controls.
    d. Kohler Power Systems; Generator Division.
    e. Onan/Cummins Power Generation; Industrial Business Group.
    f. Russelectric, Inc.

2. Transfer Switches Using Molded-Case Switches or Circuit Breakers:

    a. Eaton Electrical Inc.; Cutler-Hammer.
    b. GE Zenith Controls.
    c. Hubbell Industrial Controls, Inc.

d. Lake Shore Electric Corporation.

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. Switch Action: Double throw; mechanically held in both directions.
2. 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 Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

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. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. 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.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

G. 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: 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.
12. 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 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.5 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. 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."

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

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. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. 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. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. 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.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. 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.
    g. 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.

5. 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 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection for structures and structure elements.

1.3 SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.
2. LPI System Certificate.
3. UL Master Label Recertification.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.5 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise 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:

a. ERICO International Corporation.
b. Heary Bros. Lightning Protection Co. Inc.
c. Thompson Lightning Protection, Inc.

2. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Rods: Copper-clad steel; 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

SECTION 264313 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

D. Comply with NEMA LS 1.

E. Comply with UL 1283 and UL 1449.

F. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

A. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.9 COORDINATION

A. Coordinate location of field-mounted TVSS devices to allow adequate clearances for maintenance.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

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. ABB USA.
2. Advanced Protection Technologies Inc. (APT).
3. Atlantic Scientific.
4. Current Technology Inc.; Danaher Power Solutions.
5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
6. LEA International.
7. Liebert Corporation; a division of Emerson Network Power.
8. Siemens Energy & Automation, Inc.
9. Square D; a brand of Schneider Electric.

B. Surge Protection Devices:

1. Comply with UL 1449.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Fabrication using bolted compression lugs for internal wiring.
5. Integral disconnect switch.
6. Redundant replaceable modules.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
11. Four-digit transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.

D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120 V.
2. Line to Ground: 400 V for 208Y/120 V.
3. Neutral to Ground: 400 V for 208Y/120 V.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250 Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multiple, 60-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 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.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

C. TVSS device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect service entrance equipment to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 264313

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. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections include the following:

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 "Wiring Devices" for manual wall-box dimmers for fluorescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Ballast.
3. Fusing.
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.

6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

   a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
   b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

   1. Wiring Diagrams: Power and control wiring.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

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.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.2 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 42 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.85 or higher.
7. Power Factor: 0.95 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

2.3 FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying 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: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, 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.
9. Power Factor: 0.95 or higher.
10. Ballast Case Temperature: 75 deg C, maximum.

2.4 EXIT SIGNS

A. Description: 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, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

   a. Battery: Sealed, maintenance-free, nickel-cadmium type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.

B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

C. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

1. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
2. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) 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 (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 265100

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. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Poles and accessories.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. Luminaire: Complete lighting fixture, including ballast housing if provided.

D. Pole: Luminaire support structure, including tower used for large area illumination.

E. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Ice Load: Load of 3 lbf/sq. ft. (143.6 Pa), applied as stated in AASHTO LTS-4.

C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
1. Wind speed for calculating wind load for poles 50 feet (15 m) or less in height is 140 mph.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

    a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. 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. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

PART 2 - PRODUCTS

2.1 LUMINAIRES, GENERAL REQUIREMENTS

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. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit 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.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.2 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.3 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.

2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.

2.5 PRESTRESSED CONCRETE POLES

A. Poles: Manufactured of cast concrete.

1. Shape: Square, tapered
2. Mounting Provisions: Embedded.
3. Finishing: Capped at top and plugged at bottom. Seat each steel reinforcing strand with epoxy adhesive.
4. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole.

B. Cure with wet steam and age for a minimum of 15 days before installation.

C. Fabricate poles with a hard, nonporous surface that is resistant to water, frost, and road and soil chemicals and that has a maximum water-absorption rate of 3 percent.

D. Cast aluminum nameplate into pole wall at approximately 5 feet (1.5 m) above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.

E. Pole Brackets: Comply with ANSI C136.13.

F. Finish Color: Provided by color material complying with ASTM C 979, uniformly impregnated throughout the pole concrete. Color material shall provide a uniform, stable, permanent color and be as follows:

1. Inert, and carbon free.
2. Unaffected by environmental conditions and contaminants including, but not limited to, UV solar radiation, salts, and alkalis.

G. Finish Texture: Standard form.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

C. Adjust luminaires that require field adjustment or aiming.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m).

C. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Dig holes large enough to permit use of tampers in the full depth of hole.
2. Backfill in 6-inch (150-mm) layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

D. Raise and set poles using web fabric slings (not chain or cable).

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

A. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

END OF SECTION 265600

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS 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. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetallic wireways and auxiliary gutters.
5. Surface pathways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Division 26 Section "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
3. Division 28 Section "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Alpha Wire Company.

4. Anamet Electrical, Inc.
5. Electri-Flex Company.
6. O-Z/Gedney; a brand of EGS Electrical Group.
7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
8. Republic Conduit.
9. Robroy Industries.
10. Southwire Company.
11. Thomas & Betts Corporation.
12. Western Tube and Conduit Corporation.
13. Wheatland Tube Company; a division of John Maneely Company.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

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. Allied Moulded Products, Inc.
2. Hoffman; a Pentair company.
3. Lamson & Sessions; Carlon Electrical Products.
4. Niedax-Kleinhuis USA, Inc.

B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Mono-Systems, Inc.
b. Niedax-Kleinhuis USA, Inc.
c. Panduit Corp.
d. Wiremold / Legrand.

C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hubbell Incorporated; Wiring Device-Kellems Division.
b. Lamson & Sessions; Carlon Electrical Products.
c. Mono-Systems, Inc.
d. Panduit Corp.
e. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

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. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Lamson & Sessions; Carlon Electrical Products.
8. Milbank Manufacturing Co.
9. Molex; Woodhead Brand.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL galvanized, cast iron with gasketed cover.

J. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

K. Gangable boxes are allowed.

L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

M. Hinged-Cover Enclosures: Comply with UL 50 and 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:

a. Material: Fiberglass.
b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. 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.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Comply with TIA-569-B.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-40-PVC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-80-PVC], direct buried.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below 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: GRC. Pathway locations include the following:

   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Gymnasiums

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use cast-metal fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Pathways 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. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to RNC, Type EPC-40-PVC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. 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. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway 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.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. 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. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. 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."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line.

E. 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 enclosure.

F. Field cut openings for 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 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 27 Section "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Grout.
3. Silicone sealants.

B. Related Requirements:

1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. 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.

END OF SECTION 270544

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

D. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. 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. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of Commercial Installer, Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as Commercial Installer, Level 2 to perform the on-site inspection.

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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.8 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. Lacing bars, spools, J-hooks, and D-rings.
4. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 EQUIPMENT FRAMES

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. Cooper B-Line, Inc.
2. Hubbell Premise Wiring.
3. Leviton Voice & Data Division.
4. Panduit Corp.

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, aluminum construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
2. Baked-polyester powder coat finish.

D. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Rack-mounted, 550-cfm (260-L/s) fan with filter.
8. Power strip.
9. Baked-polyester powder coat finish.
10. All cabinets keyed alike.

E. Modular Wall Cabinets:

1. Wall mounting.
2. Aluminum construction.
3. Treated to resist corrosion.
4. Lockable front and rear doors.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Grounding lug.
8. Rack-mounted, 250-cfm (118-L/s) fan.
9. Power strip.
10. All cabinets keyed alike.

F. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot (4.5-m) line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

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. Pathways.
2. UTP cable.
3. Coaxial cable.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects,

mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

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

1. For coaxial cable, include the following installation data for each type used:

   a. Nominal OD.
   b. Minimum bending radius.
   c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:

   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

A. 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.

1.9 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: Two of each type.
2. Connecting Blocks: Two of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. 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.

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 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

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. Belden CDT Inc.; Electronics Division.
2. Mohawk; a division of Belden CDT.
3. 3M.
4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
    b. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
    c. Multipurpose: Type MP or MPG; or MPP or MPR.
    d. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    e. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

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. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Panduit Corp.
4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: Two for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 36-inch (900-mm) 48-inch1200-mm lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Secure conduits to backboard when entering room from overhead.
3. Extend conduits 3 inches (76 mm) above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

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. Pathways.
2. UTP cabling.
3. Coaxial cable.
4. Multiuser telecommunications outlet assemblies.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Telecommunications outlet/connectors.
7. Cabling system identification products.
8. Cable management system.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

I. RCDD: Registered Communications Distribution Designer.

J. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

K. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

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

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. 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.

1.9 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: Two of each type.
2. Connecting Blocks: Two of each type.
3. Device Plates: Two of each type.
4. Multiuser Telecommunications Outlet Assemblies: Two of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development] by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

E. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

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. Belden CDT Inc.; Electronics Division.
2. Genesis Cable Products; Honeywell International, Inc.
3. Mohawk; a division of Belden CDT.
4. 3M.
5. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
b. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
c. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

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. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Panduit Corp.
4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) 48-inch1200-mm lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.5 CONSOLIDATION POINTS

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. Dynacom Corporation.
2. Hubbell Premise Wiring.
3. Molex Premise Networks; a division of Molex, Inc.
4. Panduit Corp.

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:

   a. One for each four-pair UTP cable indicated.
   b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: Wall.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single or multigang faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

   a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Machine printed, in the field, using adhesive-tape label.
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.9 CABLE MANAGEMENT SYSTEM

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. iTRACS Corporation.
2. Telsoft Solutions.

B. Description: Computer-based cable management system, with integrated database capabilities.

C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

D. Information shall be presented in database view, schematic plans, or technical drawings.

1. AutoCAD drawing software shall be used as drawing and schematic plans software.

E. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Secure conduits to backboard when entering room from overhead.
3. Extend conduits 3 inches (76 mm) above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet ((4.5) m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. Low-voltage control cabling.
2. Fire alarm wire and cable.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

E. RCDD: Registered Communications Distribution Designer.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.3 FIRE ALARM WIRE AND CABLE

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. Genesis Cable Products; Honeywell International, Inc.
2. West Penn Wire/CDT; a division of Cable Design Technologies.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor[with outer jacket] with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Equipment Rooms:

1. Install cable trays to route cables if conduits cannot be located in these positions.
2. Extend conduits 3 inches (75 mm) above finished floor.
3. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Separation from EMI Sources:

1. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
2. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-

code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 CONNECTIONS

A. Comply with requirements in Division 28 Section "Fire Detection and Alarm" for connecting, terminating, and identifying wires and cables.

3.5 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 280513

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. Carbon monoxide detectors.
5. Notification appliances.
6. Remote annunciator.
7. Digital alarm communicator transmitter.

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 automatic sensitivity control of smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.

4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. 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.

1.6 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 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 a UL-listed alarm company.

1.7 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.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fire Control Instruments, Inc.; a Honeywell company.
2. Fire Lite Alarms; a Honeywell company.
3. NOTIFIER; a Honeywell company.
4. Silent Knight; a Honeywell company.
5. 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. Flame detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. 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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
5. 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. 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. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
   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 lines of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
3. The display shall also provide Light-Emitting Diodes.
   a. The 80-character display shall provide 6 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, SIGNAL SILENCED, SUPERVISORY, AND PRE-ALARM.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

   a. Initiating Device Circuits: Style B.
   b. Notification Appliance Circuits: Style Y.
   c. Signaling Line Circuits: Style 4.
   d. Install no more than 50 addressable devices on each signaling line circuit.

D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

E. 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.

F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

G. 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.

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 two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.

b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. General requirements for Carbon Monoxide Detectors:

1. Carbon monoxide detector shall be a System Sensor model number CO1224, listed to UL 2075 for Gas and Vapor Detectors and Sensors.
2. The detector shall be equipped with a sounder and trouble relay.
3. The detectors base shall be able to mount to a single-gang electrical box or direct (surface) mount to the wall or ceiling.
4. Wiring connections shall be made by means of SEMS screws.
5. The detector shall provide dual color LED indication, which blinks to indicate normal standby, alarm, or end-of-life.
6. When the sensor supervision is in a trouble condition, the detector shall send a trouble signal to the fire alarm panel.
7. When the detector gives a trouble or end-of-life signal, the detector shall be replaced.

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. 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. 75 or 110 cd.

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.

2.8 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.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm 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.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. 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.

F. Carbon Monoxide Detectors: Install where indicated on plans.

G. 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.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

K. 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. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to activate emergency lighting control.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

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 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 074020 – EXTERIOR WALL CLADDING

PART 1 GENERAL

1.1 Section Includes

A. Supply and install Prodema® Prodex pre-finished composite wood veneer panel exterior wall cladding product, as indicated on drawings, and in accordance with manufacturer requirements.

1.2 Related Work

A. Section 051223 - Structural Steel Supports.
B. Section 06100 - Rough Carpentry

1.03 Submittals

A. Product Data: Manufacturer's data sheet on each product to be used including:

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

B. Quality Assurance: Certified test results from independent testing laboratory substantiating specified performance characteristics and physical properties.
C. Design Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, and finish colors.
D. Delegated Engineer Attachment Data: Provide signed and sealed engineering indicating all fastening requirements to structural substrate in full accordance with project structural requirements and applicable Florida Building Codes.
E. Samples: Submit two complete sets of color swatches representing manufacturer’s full range of available colors, grain patterns, vein contrast and materials for each panel finish specified.
F. Installer Qualifications: Certification stating that installer is experienced in the installation of the specified products, and who has completed installations similar in extent and design with a record of successful performance.

1.05 Delivery, Storage, and Handling

A. Delivery: Deliver Materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
B. Panel Storage: Place inspected panels in a climate-controlled enclosed space. Horizontal Storage: Lay panels on an elevated flat surface with max .24” between supports to ensure even distribution of loads. Storage Time: Cannot exceed five months as of factory dispatch date. Protective peel-off sheet must be removed immediately after panel is installed.
C. Handling: Open crate within 72 hours of material delivery. Remove extra top panel and inspect contents by lifting each panel vertically to prevent chafing of the decorative face. Protect materials during handling to prevent damage.

1.07 Project Conditions

A. Do not install Prodema PRODEX material under environmental conditions where it is likely to be immersed in water, or where the temperature is likely to exceed 120 degrees Fahrenheit for extended periods of time.

PART 2 PRODUCTS

2.01 Acceptable Manufacturer

A. Prodema S.A. B San Miguel 9, 20250 Legorreta, SPAIN, Website: www.prodema.com

Represented by:

FORMAS, Inc., 5582 NE 4th Court, Suite 7B, Miami, FL 33137 Phone: (866) 776-3362
Fax: (305) 756-2067 E-mail: cecilia@formasinc.com

2.02 Materials

A. PRODEX composite Wood Veneer Exterior Wall Panel
B. Panels: Grade A rotary cut hardwood veneer from farmed forests and bonded to a bakelite core.
C. Fire Rating: Class B in accordance with ASTM E-84 criteria for flame spread 50 and smoke development 110 and Class 2 (M2) fire rating in accordance with UNE-EN 2372
D. Color: Pale
E. Panel Dimensions: 96" (2440 mm) long x 48" (1220 mm) wide x 5/16 (8mm) thick
F. Mounting: Exposed Fasteners to an Aluminum Subframe. Manufacturer - approved X-FAST system for Exposed Fastener Installation supplied by FORMAS, Inc.

PART 3 EXECUTION

3.01 Examination

Do not begin installation until substrates have been properly prepared and accepted by installer.

A. If substrate preparation is the responsibility of another installer, notify Contractor of unsatisfactory preparation before proceeding.
B. Verify compatibility of different metallic surfaces in contact with each other to protect against electro-chemical corrosion.

3.02 Preparation

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
B. Metal furring: (minimum recommended thickness) Steel - 0.060”
C. Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.
D. DO NOT use caulking, gaskets or sealants on panel face or edges.

3.03 Installation

A. Protect all sub-surfaces with appropriate weather barrier prior to mounting the rainscreen subframe. Refer to manufacturer's guide or visit www.prodema.com.
B. As with most rainscreen products a ventilated minimum unobstructed airspace of 1” is required between the structural wall and the back surface of the Prodema PRODEX panels. A minimum

gap of 3/8” between panels is also required along all perimeter edges. Refer to manufacturer's guide or visit www.prodema.com.

C. All Prodema PRODEX panels must be mounted onto vertical furring and must maintain a minimum 1” unobstructed vertical airspace to ensure proper air circulation.
D. All ventilated facades must maintain an opening of .8” at base and top to promote proper airflow (i.e. convection).
E. Gap (Joint space) along all panel edges: > .32”. Consult manufacturer for special gap conditions.
F. Cutting: Using a static circular saw with moving blade at 4000 – 6000 RPM is strongly recommended.
    1. A sharp tungsten carbide or diamond edge blade must be used to prevent splintering and affecting the face of the panel.
    2. Circular Saw: Cut panels with finished face up at a rate of approximately 20-60 ft/min.
    3. You may lightly sand cut edges to ensure a clean, crisp edge to the protective coating. Do not sand panel face.
    4. No finishing or sealing required after cutting.
G. Prior to mounting, pre-drill .32” (8mm) diameter holes when using metal furring and .29” diameter holes when using wood furring to install panels with the Prodema approved screws.
    1. Holes must be within .6” to 1.5” from the panel edge.
    2. Do not over tighten fasteners as this can damage the outer coating and inhibit thermal expansion.
    3. Screws placement must be respected using the following matrix:

These measurements represent the maximum distances between fasteners. Verify structural constraints.

Distance Between Fasteners (Flat Wall)
All panels in excess of 12” wide must be supported by a minimum of three vertical furring.

Panel Thickness	Distance Between Fasteners
.125"	12"
.25"	16"
.32", .40”	24"
.5"	32"
.55" - .87"	40"

3.04 Maintenance

A. Important: The relevant safety guidelines must be observed when using solvents and chemical cleaning products. The only maintenance the Prodema panels require is cleaning, if necessary. The panels do not require any other wood-preservation treatment.

B. Upon completion, provide Owner with product warranties and maintenance requirements.

END OF SECTION 074020

SECTION 112326 - WASHER EXTRACTOR

PART 1 GENERAL

1.1 General

A. Washer extractors.

1.2 Related Sections

A. Section 033000 - Cast-In-Place Concrete: Foundation bases for equipment.

B. Section 055000 - Metal Fabrications: Steel equipment supports.

C. Division 23 Sections for supply and exhaust fans; exhaust ductwork; service roughing-ins; drain traps; valves, pipes, and fittings; and other materials required to complete commercial laundry equipment installation.

D. Division 26 Sections for wiring disconnect switches, and other electrical materials required to complete commercial laundry equipment installation.

1.3 References

A. UL Certification: Provide electric equipment and components that are evaluated by UL for fire, and electric shock according to applicable safety standards and that are UL certified for compliance and labeled for intended use.

1.4 Submittals

A. Submit under provisions of Section 013300.

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.

C. Shop Drawings: Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.

D. Coordination Drawings: Indicate locations of laundry equipment and connections to utilities, and clearance requirements for equipment access and maintenance.

E. Operation and Maintenance Data: For laundry equipment to include in emergency, operation, and maintenance manuals. Include a schedule with the following:
1. Designation indicated on Drawings.
2. Manufacturer's name and model number.
3. List of factory-authorized service agencies including their addresses and telephone numbers.

1.5 Delivery, Storage and Handling

A. Store equipment on site protected from weather, direct sunlight and temperature extremes. Do not remove packaging prior to storage.

B. Consult manufacturer if machines are to be stored for an extended period of time.

1.6 Project Conditions

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 Warranty

A. Washer Extractor Parts Only, Mainframe, Cylinder Shaft Assembly, and Bearings Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace main frame, bearing, cylinder or cylinder shaft assembly that fails within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 Manufacturers

A. Acceptable Manufacturer: UniMac, which is located at: Shepard St. P. O. Box 990; Ripon, WI 54971-0990; Toll Free Tel: 800-587-5458; Fax: 920-748-1664; Email:request info (leads@alliancels.com); Web:www.unimac.com

B. Requests for substitutions will be considered in accordance with provisions of Section 012500.

2.2 Materials

A. Washer Extractors - Stainless Steel: ASTM A 666, Type 304 with No. 4 finish (directional satin finish) on exposed surfaces.

2.3 UW Series High Performance Washer Extractor Models and Components

A. Model UWN065T4V General Characteristics:
1. Frame: Heavy-duty structural plate steel frame.
2. Construction: Cabinet front, top, sides and inner and outer tubs, 304 grade stainless steel.
3. Control System: UniLinc.
4. Cylinder Drive: Programmable inverter drive with rotation.
5. Chemical Supply System: Automatic flushing and connections for 5 external supply lines and control signals for 8 external supplies.
6. Rapid jet-spray rinse system.
7. Drain Valve: Automatically opens in event of power failure.

B. Model No. UWN065T4V:
1. Dry Weight Capacity: 65 lb (20 kg).
2. Wash Cylinder Volume: 9.61 cu. ft. (272125 cu cm) minimum.
3. Number of Speeds: 5,6,9 by speed selector.
4. Number and Size of Water Inlet Valves: 4 at 3/4 in (19 mm), all with 3/4 NH male connectors.
5. Number and Size of Drain Outlets: 1 at 3 in (76 mm).
6. Drive Motor: 5 hp (3.7 kW).

7. G Force: 27/Very Low, 100/Low, 200/Medium, 250/High, 300/Very High, 400/Ultra High.
8. Electrical Requirements: 208v-240v/60Hz/3 phase.

2.4 Examination

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.5 Preparation

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

2.6 Installation

A. Install in accordance with manufacturer's instructions.

B. System Startup and Commissioning: Arrange for a local manufacturer's representative to inspect machines prior to startup and operation.

2.7 Protection

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

2.8 Demonstration

A. Schedule demonstration with representative of the Owner at time of turn over.

END OF SECTION 112326

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Electric Traction Elevators.

B. Products Supplied But Not Installed Under this Section:

1. Hoist Beam

2. Pit Ladder

3. Inserts mounted in block walls for rail attachments

C. Work Supplied Under Other Sections:

1. Temporary lighting, including temporary lighting in hoistway for machine space with switch located in hoistway on the strike jamb side of top landing door.

2. Main line disconnects for each elevator.

   a. One fused three phase permanent power in building electrical distribution room

   b. One non fused three phase permanent power in hoist way at top landing

3. Hoistway ventilation shall be in accordance with local and national building code requirements.

4. Guide Rail Support shall be structurally adequate to extend from pit floor to top of hoistway, with spans in accordance with requirements of authority having jurisdiction and final layouts.

5. Removable barricades at all hoistway openings, in compliance with OSHA 29 CFR 1926.502 in addition to any local code requirements.

6. Lifeline attachments capable of withstanding 5000 lb load in accordance with OSHA 29 CFR 1926.502. Provide a minimum of 2 at the top, front of each hoistway.

7. Pit lighting: Fixture with switch and guards. Provide illumination level equal to or greater than that required by ASME A17.1/CSA B44 2000, or applicable version.

8. Control space lighting with switch. Coordinate switch with lighting for machine space as allowable by code.

C. Related sections:

1. Section 015000 - Temporary Facilities and Controls

2. Section 033000 - Cast-in-Place Concrete:

3. Section 042000 - Unit Masonry

4. Section 055000 - Metal Fabrications

5. Section 071600 - Cementitious Waterproofing
6. Section 230000 - Heating, Ventilating, and Air Conditioning
7. Section 260000 - Electrical
8. Section 263000 - Electric Power Generating and Storing Equipment
9. Section 273000 - Voice Communications
10. Section 283100 - Fire Detection and Alarm
11. Section 310000 - Earthwork

D. Industry and government standards:

1. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
2. ADAAG - Accessibility Guidelines for Buildings and Facilities
3. ANSI/NFPA 70, National Electrical Code
4. ANSI/NFPA 80, Standard for Fire Doors and Fire Windows
5. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.

1.02 DESCRIPTION OF ELEVATOR

A. Elevator Equipment: KONE EcoSpace™ gearless traction elevator

B. Equipment Control: KCM831

C. Drive: Regenerative

D. Quantity of Elevators: 1

E. Landings: 2

F. Openings: 1 Front Openings, 0 Back Openings

G. Travel: 14’

H. Rated Capacity: 3000 lbs

I. Rated Speed: 150 fpm

J. Clear Inside Dimensions (W x D): 8’-6” x 6’-3”

K. Cab Height: 8' 0"

L. Clear height under suspended ceiling: 13’

M. Entrance Width and Type: 3’6 and Left

N. Entrance Height: 7' 0"

O. Main Power Supply: 208 Volts + 5%, three-phase

P. Operation: Simplex

Q. Machine Location: Inside the hoistway mounted on car guide rail

R. Control Space Location: See drawings

S. Maintenance Service Period: 12 months

1.03 PERFORMANCE REQUIREMENTS

A. Car Performance

1. Car Speed ± 5% of contract speed under any loading condition or direction of travel.

2. Car Capacity: Safely lower, stop and hold (per code) up to 125% of rated load.

B. System Performance

1. Vertical Vibration (maximum): 25 mg

2. Horizontal Vibration (maximum): 25 mg

3. Jerk Rate (maximum): 1.3 ft/sec3

4. Acceleration (maximum) 1.3 ft/sec2

5. In Car Noise: = 55 dB(A)

6. Leveling Accuracy: ±0.2 inches

7. Starts per hour (maximum): 120

1.04 SUBMITTALS

A. Comply with Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer's product literature for each proposed system.

1. Cab design, dimensions and layout.

2. Layout, finishes, and accessories and available options.

3. Controls, signals and operating system.

4. Color selection charts for cab and entrances.

C. Shop Drawings:

1. Clearances and travel of car.

2. Clear inside hoistway and pit dimensions.

3. Location and layout of equipment and signals.

4. Car, guide rails, buffers and other components in hoistway.

5. Maximum rail bracket spacing.

6. Maximum loads imposed on building structure.

7. Hoist beam requirements.

8. Location and sizes of access doors.

9. Location and details of hoistway door and frames.

10. Electrical characteristics and connection requirements.

D. Operation and maintenance data:

1. Provide manufacturer's standard maintenance and operation manual.

E. Diagnostic Tools

1. Prior to seeking final acceptance for the completed project as specified by the Contract Documents, the Elevator Contractor shall deliver to the Owner any specialized tool(s) that may be required to perform diagnostic evaluations, adjustments, and/or parametric software changes and/or test and inspections on any piece of control or monitoring equipment installed. This shall include any specialized tool(s) required for monitoring, inspection and/or maintenance where the means of suspension other than conventional wire ropes are furnished and installed by the Elevator Contractor. Any and all such tool(s) shall become property of the Owner. Any diagnostic tool provided to the Owner by the Elevator Contractor shall be configured to perform all levels of diagnostics, systems adjustment and parametric software changes which are available to the Elevator Contractor. In those cases where diagnostic tools provided to the Owner require periodic recalibration/or re-initiation, the Elevator Contractor shall perform such tasks at no additional cost to the Owner for a period equal to the term of the maintenance agreement from the date of final acceptance of the competed project During those intervals in which the Owner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation, or repair, the Elevator Contractor shall provide a temporary replacement for the tool at no additional cost to the Owner. The Elevator Contractor shall deliver to the Owner, printed instructions for the proper use of any tool that may be necessary to perform diagnostic evaluations, system adjustment, and/or parametric software changes on any unit of microprocessor-based elevator control equipment and means of suspension other than standard elevator steel cables furnished and install by the Elevator Contractor. Accompanying the printed instructions shall be any and all access codes, password, or other proprietary information that is necessary to interface with the microprocessor-control equipment.

1.05 QUALITY ASSURANCE

A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.

B. Installer: The equipment manufacturer shall install the elevator.

C. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's recommendations for delivery, storage and handling.

B. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional lablor costs for double handling will be the responsibility of the general contractor.

C. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.07 WARRANTY

A. Provide manufacturer warranty for a period of one year. The warranty period is to begin upon Substantial Completion of the Contract. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse, or neglect do not constitute defective material or workmanship.

1.08 MAINTENANCE SERVICE

A. The elevator manufacturer shall provide maintenance service consisting of regular examinations and adjustments of the elevator equipment for a period of 12 months after date of substantial completion. Replacement parts shall be produced by the original equipment manufacturer.

B. Maintenance service be performed during regular working hours of regular working days and shall include regular time call back service.

C. Maintenance service shall not include adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents.

PART 2 PRODUCTS

2.02 MANUFACTURER

A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:

1. Basis of Design: EcoSpace™ traction elevators by KONE, Inc. (www.kone.com).

2. Other acceptable machine room-less products: manufacturer with minimum 15 years experience in manufacturing, installing, and servicing elevators of the type required for the project.

1.02 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

A. Controller: Provide microcomputer based control system to perform all of the functions.

1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.

2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.

3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.

4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.

B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.

C. Controller Location: Locate controller in the front wall integrated with the top landing entrance frame, machine side of the elevator. A separate control space should not be required.

2.01 EQUIPMENT: HOISTWAY COMPONENTS

A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.

B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.

C. Buffers, Car and Counterweight: Oil Buffer

D. Hoistway Operating Devices:

1. Emergency stop switch in the pit

2. Terminal stopping switches.

3. Emergency stop switch on the machine

E. Positioning System: System consisting of magnets and proximity switches.

F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

2.03 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoistway Entrances

1. Sills: extruded.

2. Doors: Hollow metal construction with vertical internal channel reinforcements.

3. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.

4. Entrance Finish: Brushed Stainless Steel.

5. Entrance Markings Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.04 EQUIPMENT: CAR COMPONENTS

A. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.

B. Platform: Platform shall be all steel construction.

C. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

D. Steel Cab Finish: Stainless Series

1. Car Wall Finish: Brushed Stainless Steel

2. Car Front Finish: Brushed stainless steel.

3. Car Door Finish: Brushed stainless steel.

4. Ceiling:

a. Round LED Down Light Drop Ceiling - LF-88: Satin Finished Stainless Steel three panel suspended ceiling with two holes per panel for Round LED lights.

6. Handrail:

a. Rails to be located on side and back wall of car enclosure.

7. Flooring: Terrazzo. See specification section 096613.

8. Threshold: Aluminum

E. Emergency Car Signals

1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.

2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.

3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

4. Ventilation: No fan.

2.02 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation. Fixture finish to be: Textured Stainless Steel.

1. Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have white illumination (halo). All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be white DOT-matrix. All texts, when illuminated, shall be white. The car operating panel shall have a brushed stainless steel finish.

2. Additional features of car operating panel shall include:

   a. Car Position Indicator within operating panel white.

   b. Elevator Data Plate marked with elevator capacity and car number on car top.

   c. Help buttons with raised markings.

   d. In car stop switch per local code.

   e. Firefighter's hat.

   f. Firefighter's Phase II Key-switch.

   g. Call Cancel Button.

   h. Pre-programmed integrated ADA phone (complete description of krms features included as standard)

   i. Help Button/Communicator. Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.

   j. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.

B. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a brushed stainless steel finish.

   1. Vandal Resistant Hall fixtures shall feature round, mechanical, illuminated buttons in flush fixture housings. Hall fixtures shall correspond to options available from that landing.

C. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down.

D. Hall Lanterns and Chime: A directional lantern visible from the corridor shall be provided at each hall entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down.

2.03 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

A. Elevator Operation

B. Standard Operating Features to include:

1. Full Collective Operation

2. Fan and Light Control.

3. Load Weighing Bypass.

4. Ascending Car Uncontrolled Movement Protection

5. Top of Car Inspection Station.

C. Additional Operating Features to include:

1. Provision for Card Reader in Car (Card Reader provided and Installed by others)

2. Provide provisions for coaxial cable for CCTV. CCTV by others.

3. Intercom Provisions

4. Emergency Battery Power Supply

a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. The elevator will rise or lower to the first available landing, open the doors, and shut down. The elevator will return to service upon the return of normal main line power. An auxiliary contact on the main line disconnect and shunt trip breaker (if used) will be provided by others.

D. Elevator Control System for Inspections and Emergency

1. Provide devices within controller to run the elevator in inspection operation.

2. Provide devices on car top to run the elevator in inspection operation.

3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.

4. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.

5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.

6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.

7. Provide the means for the control to reset elevator earthquake operation.

2.07 EQUIPMENT: DOOR OPERATOR AND CONTROL

A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.

B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.

E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 EXECUTION

3.06 EXAMINATION

A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.

B. Do not proceed with work until unsatisfactory conditions are corrected.

C. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: -0 inches +2 inches. Do not begin work of this section until dimensions are within tolerances.

D. Prior to start of Work, verify projections greater then 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less then 75 degrees from horizontal.

E. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.

F. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.

G. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.

H. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.07 PREPARATION

A. Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.08 INSTALLATION

A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.

D. Lubricate operating system components in accordance with manufacturer recommendations.

E. Perform final adjustments, and necessary service prior to substantial completion.

3.09 CONSTRUCTION

A. Interface with Other Work:

1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.

2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.

   a. Ensure adequate support for entrance attachment points at all landings.

   b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.

   c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.

   d. Coordinate interface of elevators and fire alarm system.

   e. Coordinate interface of dedicated telephone line.

3.10 TESTING AND INSPECTIONS

A. Perform recommended and required testing in accordance with authority having jurisdiction.

B. Obtain required permits and provide originals to Owner's Representative.

3.11 DEMONSTRATION

A. Prior to substantial completion, instruct Owner's Representative on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

END OF SECTION

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing site utilities.
7. Temporary erosion- and sedimentation-control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed or as identified on the plans.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. Contractor shall call 811 to have all public utility lines located prior to commencing the clearing operation.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and any tree protection measures are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.

5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements, intended to be salvaged, to their original condition, as determined to be acceptable by Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction, and a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to the requirements in the Landscape Plans.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: 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:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

C. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
2. Use only hand methods for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase and base courses for concrete walks and pavements.
5. Subbase and base courses for asphalt paving.
6. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt or concrete paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference at project site with the Geotechnical Engineer responsible to monitor earthwork operation. Contractor shall follow the recommendations made in the "Report of Geotechnical Exploration, Proposed ED/ OR Expansion, Broward Health North" prepared by Nutting Engineers of Florida, Inc., dated February 2014.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

B. Do not commence earth moving operations until plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, SW and SP according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve, less than 5 percent organic content and not more than 10 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve. Use limerock meeting FDOT specifications or approved equivalent.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve, less than 5 percent organics and not more than 10 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 10 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel (exclusive of limerock or other cementing material); ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 3 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements defined by the Landscape Plan and associated specifications.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls to natural soil repose.

1. Clearance: 12 inches each side of pipe or conduit or as required to meet OSHA standards.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support

for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for a compacted bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to the Landscape Plan and associated specifications.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements as identified in the Geotechnical Report identified in Section 1.3.A. with a vibratory roller (or approved alternate compaction mechanism) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect/ Geotechnical Engineer.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in the plans.

D. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and re-compact top 24 inches of existing subgrade and each layer of backfill or fill soil material to 98 percent maximum modified Proctor dry density.

2. Under walkways, scarify and re-compact top 12 inches below subgrade and compact each layer of backfill or fill soil material to 98 percent maximum modified Proctor dry density.

3. Under turf or unpaved areas, scarify and re-compact top 6 inches below subgrade and compact each layer of backfill or fill soil material to 95 percent maximum modified Proctor dry density.

4. For utility trenches, compact each layer of initial and final backfill soil material to 98 percent maximum modified Proctor dry density.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place sub-base course and base course on subgrades free of mud or excessive moisture.

B. On prepared subgrade, place sub-base course and base course under pavements and walks as follows:

1. Shape sub-base course and base course to required crown elevations and cross-slope grades.
2. Place sub-base course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches.
3. Compact sub-base course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum modified Proctor dry density according to ASTM D 1557.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE (IF REQUIRED BY GEOTECHNICAL ENGINEER DURING CONSTRUCTION)

A. Place drainage course on subgrades free of mud and excessive moisture.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner (or Contractor as defined in the general specifications section) will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312300 - SITE PREPARATION, EXCAVATION AND EARTHWORK FOR FOUNDATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All requirements of Division 0 and Division 1 forms a part of this section.

B. A subsurface investigation and soils report have been completed for this project. All work in this section shall comply with the soils report.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with federal, state, local, and other duly constituted authorities in matters pertaining to:

1. Permitting
2. Disposal of and hauling of waste material
3. Safety precautions
4. Barricades
5. Protection of environmental matters

1.3 SCOPE OF WORK

A. Perform all work specified herein as indicated within the grading area, i.e., that area within which earth grades are shown to be approximately 5 feet outside building perimeter. Remainder of property is to be left undisturbed, except as otherwise authorized for such purposes as spoil or stock pile areas, temporary ditches, swales and/or haul or access roads, in which case such authorized areas become part of the grading area. This work includes, but is not limited to, the following:

1. Clearing and grubbing of vegetation and debris of all kinds.
2. Stripping.
3. Excavating to grade and subgrades.
4. Excavating and backfilling for foundations.
5. Providing finish load-bearing subgrades for foundations.
6. Disposal of removed materials.
7. Dewatering.
8. Laboratory testing.

B. Related work not specified under this subdivision.

1. Excavation of backfill for utilities.
2. Finish grading.

1.4 GENERAL

A. Contractor shall obtain a copy of the soils report for use with this section.

B. The Contractor shall examine all drawings and the specifications, consulted the records of adjacent construction and of any existing utilities, and the connections, if any, and noted all conditions and limitations which may influence the work required by this Section.

C. Where recommendations presented in the soils report conflict with this section, the soils report shall govern.

1.5 EXISTING STRUCTURES

A. Care shall be exercised during excavation, backfilling, and compaction work to avoid damage to existing buildings or foundations.

1.6 PROTECTION

A. Protect trees and dispose of all removed trees including stumps and roots.

B. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular traffic.

C. Protect above and below grade utilities which are to remain.

D. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave in or loose soil from falling into excavation.

E. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

F. Control grades in vicinity of excavations to prevent surface water running into excavated areas.

G. Conduct earthwork operations under this division to insure against rainwash and silting of watercourses, ponds and adjoining property resulting therefrom. Should such silting occur, restore such areas to their original condition if outside the grading areas, or to lines, grades and conditions shown specified if within grading areas, all at no cost to the Owner.

PART 2 - MATERIALS

2.1 FILL MATERIALS

A. Fill material shall be as specified in the soils report or at least clean fine sand, free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition.

B. Source of new material and length of haul shall be the Contractor's responsibility.

C. Drainage fill: Crushed stone or gravel so that 100% passes 1-1/2" sieve with not more than 10% passing a No. 4 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum.

1. Identify known underground utilities. Stake and flag locations.
2. Identify and flag surface and aerial utilities.
3. Notify companies to remove and relocate utilities as required.
4. Maintain and protect existing utilities remaining which pass through work area.

B. If required, perform remedial de-watering prior to any earthwork operations.

C. Clear and grub site as defined in the soils report.

D. Proof-roll the sub-grade in accordance with the soils report and under the observation of the testing laboratory. Proof-rolling will help locate any zones of especially loose or soft soils not encountered in the soil test borings. Then undercut, or otherwise treat these zones as recommended by the testing lab.

E. Testing the sub-grade for compaction will be as directed by the testing laboratory and as shown on the structural drawings.

3.2 FILL

A. Fill in areas where required shall be placed in loose lifts as directed by the soils report.

B. In load-bearing areas, fill shall be compacted as recommended in the soils report or at least to 95% of maximum modified Proctor dry density. A moisture content within two percent (2%) points of optimum indicated by the modified Proctor test (ASTM D-1557) is recommended.

C. Perform compliance tests within the fill as directed by the testing lab.

3.3 EXCAVATION

A. Excavation shall conform to the dimensions and elevations shown on the drawings, but excavation lines shall be such as to provide sufficient clearance for the proper execution of the work to be installed. Allowances shall be made for work and inspections. Bottom of all excavations shall be trimmed to the levels indicated and sloping surfaces cut in steps shown on drawings. After carrying the excavation to the required depth, the Contractor shall await the inspection and testing of the bearing soil.

B. Control of ground water, including all necessary equipment, to maintain all excavated areas in a dry condition shall be the responsibility of the Contractor.

C. Sides of temporary excavations can be cut to maximum slope of 1:1. However, no claim may be made by the Contractor for extra work for damages resulting from slope stability failure.

D. The bottom of foundation excavations shall be compacted after excavation to densify any soils loosened in the excavation process. Backfill soils placed adjacent to footing or walls shall be carefully compacted with a light rubber tired roller or vibratory plate compactor to avoid damaging the footings and walls. Approved sand fills placed in footing excavations above the bearing level, in trench excavations, and in other areas which are expected to provide slab support and foundation embedment constraint shall be placed in loose lifts not exceeding 6 inches and shall be compacted to a minimum of 95% of the maximum modified Proctor dry density.

E. Test all footing cuts for compaction to a depth of 1 foot, as directed by the testing laboratory.

3.4 DEWATERING

A. Refer to the soils report for an estimate of seasonal high ground water table.

B. The geotechnical testing laboratory shall determine the depth of ground water just prior to construction to determine what dewatering will be required.

C. Water control will consist of, but not necessarily be limited to, well points, sumps, and pumps, in conjunction with berms and any needed ditches. Deep wells will not be permitted.

D. Approval by the Architect of data submitted shall not relieve the Contractor of full responsibility for adequacy of dewatering system. In the event that during the progress of the work it is determined that the dewatering system is inadequate, the Contractor shall install and operate such additional dewatering equipment and/or make such changes in the system or plan of operation as may be necessary to perform the dewatering system in an adequate manner.

E. Groundwater shall be maintained at least 24 inches below all earthwork, foundations, and compacted surfaces, or as directed by the testing laboratory.

3.5 BACKFILL UNDER AND AROUND BUILDING AREA

A. All debris shall be removed from excavations prior to backfilling and filling.

B. Backfill under and around building area shall be placed in loose layers not exceeding 12" and shall be compacted as defined in the soils report or at least to a density equal to 95% of the modified Proctor maximum dry density as per ASTM D698-70.

C. Backfill in electrical plumbing and mechanical trenches shall be compacted to previously specified density.

3.6 GRADING

A. Grade areas to lines and elevations indicated, including adjacent transition areas. Smooth finish surface within specified tolerances. Compact and bring to uniform levels or slopes between points where elevations are shown or between such points and existing grades.

B. Unless shown on the drawings, slope the grade evenly to provide drainage away from the building.

C. Complete the grading operations after the building has been finished, utilities installed, site improvements constructed, and all excavated materials, rubbish, and debris removed from the site. Leave grade for lawns and planted areas clean and at required grades.

3.7 TESTING

A. A qualified licensed geotechnical testing laboratory shall be retained to perform all necessary quality control testing for earthwork.

B. All testing shall comply with the project soils report.

C. See structural drawings for a minimum testing program.

D. Provide samples of materials proposed for fills as required. Cooperate with laboratory personnel in obtaining samples, and during quality control testing.

3.8 SPECIAL NOTES

A. Fill material shall not be placed against walls until 7 days after grouting of masonry cells. Compaction of exterior fill and interior backfill shall not be performed until wall grout has cured 14 days.

B. Do not use drum compactor within 6 feet of walls. Compaction within 6 feet of walls shall be accomplished with a hand operated vibratory compactor.

END OF SECTION 312300

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt paving.
3. Hot-mix asphalt overlay.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by FDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of FDOT “Standard Specifications for Road and Bridge

Construction", latest edition for asphalt paving work. For type "S" asphalt comply with the year 2000 edition of said publication.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-22.

B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent or more than 15 percent by weight.

1. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes type S-1 or S-3 as defined in the plans and complying with the following requirements:

1. Provide mixes that meet the requirements of FDOT "Standard Specifications for Road and Bridge Construction (2000)".
2. Base Course: Use of asphalt as a base material is prohibited unless specifically identified on the plans.
3. Surface Course: Provide either S-1, S-3 or combination of said asphalt mixes as defined on the plans.

PART 3 - EXECUTION

3.1 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1 inch.
2. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that

prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at a minimum temperature of 250 deg F.
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course (if applicable): Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course (if applicable): 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan, or otherwise, Contractor is responsible for the removal of said waste from the job site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Curbs and gutters.
3. Walks.

1.2 ACTION SUBMITTALS

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

B. LEED Submittals (if applicable):

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Samples: For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

F. Deformed-Steel Wire: ASTM A 496/A 496M.

G. Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767, Class I coating. Cut bars true to length with ends square and free of burrs.

H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.2 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, white portland cement Type I. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.3 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color: White, yellow and/ or blue as indicated on the plans.

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, yellow and/ or blue as indicated on the plans.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 4,000 psi and 3,000 psi as identified on the plans for the various concrete systems.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 6 percent plus or minus 1.5 percent.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

C. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Proof-roll prepared subbase and base (if applicable) surface below concrete paving to identify soft pockets and areas of excess yielding.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

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

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving:

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed paving surface with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions.

1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these means.

3.8 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/2 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/2 inch.
4. Joint Spacing: 20 ft. maximum.
5. Contraction Joint Depth: Plus 1/4 inch no minus.
6. Joint Width: Plus 1/8 inch.

3.9 PAVEMENT MARKING

A. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 328400 – PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 RELATED WORK

A. Section 312000 – Earth Moving.

B. Section 329300 – Plants

C. Section 260519 – Low voltage electrical power Conductors and Cables

1.3 SUBMITTALS

A. Prior to and during construction prepare As-Built drawings on reproducible bases showing deviations in the work that are made during construction.

1. Show deviations affecting but not limited to main line pipe, laterals and zone pipe, controller locations, pipe and wire sleeves, backflow preventer, remote control valves, and valve boxes.
2. Indicate approved substitutions by size, material and manufacturer's name and catalog number.
3. Label each As-Built drawing and maintain them separate from the drawings used for construction.

B. Submit As-Built drawings to the City prior to final inspection of the work.

C. Warranty/Guarantee letter.

D. Product Data: Submit manufacturers complete data sheets for all materials specified on plans.

1.4 JOB CONDITIONS

A. Become familiar with site conditions. Should utilities not shown on the plans be found during excavations, promptly notify the City for instructions on how to proceed.

B. Make necessary adjustments in the layout as may be required to connect to existing water mains, should such pipe mains not be located exactly as shown, and as may be required to work around existing work.

1.5 QUALITY ASSURANCE

A. The work shall conform to the latest requirements of local, state, and federal agencies, as appropriate.

B. Notify the City 24 hours in advance of starting the work.

C. Contractor shall be responsible for all applicable codes and/or ordinances. Notify the City if variances are found between the Drawings and any code requirements.

1.6 WARRANTY

A. Fully warrant the landscape irrigation system for a period of one (1) year after the written final acceptance.

B. During the warranty period, enforce manufacturer's and supplier's warranties. Malfunctions, deficiencies, breaks, damages, disrepair or other disorder due to materials, workmanship, or installation by the contractor and his suppliers shall be immediately and properly corrected.

C. Repair damages caused by system malfunction.

D. Contractor shall repair damage or malfunction within seven (7) days of written notification by the City of Miramar.

PART 2 - PRODUCTS

2.1 PIPE:

A. PVC Pipe:
1. As indicated on the Irrigation Drawings.
2. All Pipe need to be ‘Purple’ to indicate a reclaimed water source.
3. Solvent weld cement shall be colored with primer of a contrasting color and be easily recognizable from the pipe itself.

B. Class 200 Pipe
1. As indicated on the Irrigation Drawings.

C. Schedule 40 Pipe
1. As indicated on Irrigation Drawings.

D. Accessories:
1. Joint restraints.
2. PVC sleeves for pipe and control wiring shall be schedule 40 PVC and have an inside diameter twice the diameter of the pipe and/or wire bundle it is to hold plus one inch. Plainly mark sleeves in field and on As-Built drawings for future ease of location.

2.2 ELECTRIC ZONE CONTROL VALVES

A. Manufacturer:
1. As indicated on the Irrigation Drawings.

B. Products:
1. As indicated on the Irrigation Drawings.
2. Valves shall be 'Purple' to indicate reclaimed water use/source.

2.3 VALVE BOXES

A. Manufacturer:
1. As indicated on the Irrigation Drawings.
2. Valve Boxes set in hardscape / walk areas shall be concrete material or vehicle-rated composite material. Color to match hardscape.
3. Valve Boxes set in landscape areas to be composite plastic, 'Black' body with 'Green' covers.

B. Products:
1. Minimum box size for electric control valves: 12" rectangular.
   a) For Boxes in Landscape beds or sod: Box shall be composite plastic, black with green cover with irrigation control valve designation molded into the cover. All boxes shall match.
   b) For Boxes set in walks/hardscape areas: Box shall be heavy-duty composite plastic or concrete - color to match surrounding hardscape surfaces(s).
2. Crushed 3/4" drain rock shall be placed 12" deep beneath the valve box with the top of the box set 2" above finish grade.

2.4 IRRIGATION SYSTEM CONTROLLERS

A. Manufacturer:
1. As indicated on the Irrigation Drawings. Irrigation for this project will tie into Master Irrigation system for the Town Center. Tie control wires to master controller.

B. Products:
1. As indicated on the Irrigation Drawings.

2.5 MOISTURE CONTROL SENSOR

A. Products:
   1. As indicated on the Irrigation Drawings. Irrigation for this project will tie into Master Irrigation system for the Town Center. Rain Sensor is existing and part of the Master System.

2.6 IRRIGATION CONTROL WIRE

A. Products:
   1. As indicated on the Irrigation Drawings.

2.7 BACKFLOW PREVENTER

A. Products:
   1. As indicated on the Irrigation Drawings.

2.8 GATE VALVES

A. Products:
   1. As indicated on the Irrigation Drawings.

PART 3 – EXECUTION

3.1 GENERAL

A. The layout shown on the plans and drawings for the irrigation are schematic in nature in order to indicate the work to be done. Locate pipe, valves, and equipment under walks and provide valve boxes for equipment. Provide sleeved pipe, and control wire crossing under paving, walls and hard surfaces.

B. Install the irrigation system in accordance with governing codes, approved shop drawings, and contract drawings and specifications.

C. Coordinate the water source connection with other contractors on the project.

D. Where applicable, Irrigation system shall provide 100% head to head coverage.

E. Provide bubblers for all Palms and trees.

F. Irrigation main lines shall not be installed under major structures or concrete slabs.

G. There is one point of connection (P.O.C.). The water source is an existing 4" stub-out from the Town Center's Master Irrigation System. This P.O.C. must be capable of delivering a minimum of 80 GPM at 50 PSI. Contractor shall notify City immediately if these minimums cannot be established.

3.2 PREPARATION

A. Layout sprinkler main lines and perform line adjustments and site modifications to laterals prior to excavation. Sprinkler line should not be installed under concrete slab unless encased within sleeve.

B. Locate valves to assure ease of access for maintenance and that no physical interference with other elements of the project exists.
   1. When feasible, bank valve boxes together in planter beds or on the sidewalk together. Boxes should be arranged in an orderly fashion.
   2. In planter beds: Valve boxes shall be placed a minimum of 12" and a maximum of 18" from the edge of pavement or walk or curb or other hardscape surface or element. No valve boxes shall be installed in turf beds without approval by the City. Set boxes so their top surface is flush with the top of the planter bed's mulch layer.
   3. In hardscape surfaces: Set valve boxes orthogonal to hardscape edges, walls or curb lines. Review layout of boxes with the Owner's project representative. Set box covers flush with the surrounding hardscape surfaces. Install so there is no settling.

C. Furnish temporary support, adequate protection, and maintenance of all underground and surface utilities, structures, drains, sewers, and other obstructions encountered in the progress of the work.

3.3 PIPE INSTALLATION

A. Preparation:
   1. Stake pipe locations and check for uniformity of spacing and correctness of pattern.
   2. Maintain warning signs, shoring, barricades, flares, red lanterns, or other required warning devices.
   3. Carefully inspect pipe and fittings before installation in the trench and do not use damaged materials.

B. Excavation:
   1. Excavation shall be unclassified and shall include all materials encountered in the excavation of trenches for pipe and other product installation.
   2. The trench shall be of sufficient width and depth for installation of the pipe.
   3. Cause minimum disturbance to existing conditions; bore under existing pavement and sidewalks rather than cut and restore. Do not cut pavement without written permission of the City.
   4. Remove rocks over ½" in diameter and unsuitable bearing material from the trenches.

C. Installation:

1. Compression Joints:
   a. Make the bell end of compression joints clean and dry, and install the proper compression ring without lubricant and in the proper position.
   b. Clean and lubricate the spigot end with the Manufacturer's recommended lubricant. Push "home" the spigot end as indicated when the manufacturer's reference mark is flush with the end of the bell.
   c. Carefully lay the completed joint in the trench.
2. Solvent-Welded Pipe and Joints:
   a. Make solvent weld joint only with clean, dry, square-cut, smooth pipe sections. "Dry" test the fitting for proper size before solvent is applied.
   b. "Snake" solvent-weld pipe sections from side to side in the trench to prevent joint rupture due to thermal contraction.
   c. Pipe must cure a minimum of 30 minutes prior to handling and placing into trenches. The pipe must cure a minimum of 24 hours prior to filling with water.
3. Plug pipe openings during construction to prevent entrance of foreign materials.
4. Sleeves:
   a. Place pipe and electrical wiring to be installed under paving, curbs, walks, pavers and other hard surfaces in Schedule 40 PVC sleeves.
   b. Extend sleeve beyond the paved areas as indicated on the irrigation drawings or as code requirements requires.
5. Backfill:
   a. Carefully place backfill to avoid pipe dislocation.
   b. Use only backfill material free of rocks, stumps, roots and other unsuitable material.
   d. Place backfill in six inch (6") lifts and compact, except in planting areas where planting soil is used. Compact backfill to be under pavement or sidewalks to 100% of maximum A.A.S.H.T.O. T-180 density. Make the surface of backfilled trenches even with the surrounding ground surface after compaction.
   e. Backfill shall be installed so the following minimum depths are maintained: 24" for all sleeving, 18" for the main line and 12" for all lateral pipes.
6. Sprinkler Heads:
   a. Minimum two '<u>Purple</u>' (2) bubblers per Royal Palm tree in tree pit area. Minimum one (1) bubbler for trees and Date Palms.
   b. Low angle spray heads in planter beds.
   c. No drip irrigation.
7. Other:
   a. No risers in plant beds adjacent to walkways or storefront windows.
   b. Spray heads in planters / landscape beds to be 12-inch pop-ups unless on risers.

c. Provide irrigation to plant material in pots. Refer to Planting Details.

d. At each pot, place a valve box for irrigation under each pot location – set top of box flat and flush with pavers/walkway.

3.4 CONTROLLER INSTALLATION

A. Coordinate the work with the installer of the electrical supply.

D. Make electrical connections and hook-ups as necessary for the complete automatic operation of the irrigation systems.

E. Install the wall-mounted controller within the structures as specified on the plan. Coordinate power supply with electrical contractor.

3.5 CONTROL WIRE INSTALLATION

A. Do not make underground splices except at electric valves in valve boxes. Make splices waterproof and cover with heat shrink boots made for irrigation wire direct buried connections.

B. Place all control wire in grey 1 ½" or larger Schedule 40 PVC conduit as needed for wire capacity, 18" minimum burial.

H. Wire sized, numbered and colored as follows:

#12 white for common
#12 spare black common (1per 10 hot wires – minimum of 1 spare)
#12 red for hot wires
#12 spare yellow hot wires (provide 1 spare for every 10 wires – minimum of 2 spare)

D. At all remote control valve box locations coil wire around a ¾" piece of PVC pipe to make a coil using 30 linear inches of wire. Provide no less than 18" of coil wire above top of valve box.

3.6 TESTING AND INSPECTION

A. General:

1. All items of construction and operation of the irrigation system are subject to inspection and testing. Work items may be rejected because of non-compliance with the Drawings and specifications, non-suitability, poor materials, inadequate workmanship or improper assembly or other causes which would prevent the system from functioning properly, or which in the City's opinion would be detrimental to the longevity of the irrigation system, or which would necessitate excessive manual labor and maintenance.

2. Furnish labor, materials, and equipment required for testing and inspections. Work stoppages for testing, re-testing, inspection and replacement or repair shall not add to the allocated time of completion or cost of the work.

3. Final inspection will be made when the complete system is in place, operable, and all repairs, additions, adjustments and other work is complete. At such time, adequately demonstrate the proper operation of the system, showing the system's conformance with the Drawings and Specifications, and demonstrating that the irrigation system gives proper and adequate coverage of all landscaped areas. Final inspection will not take place until approved as-builts are issued.
4. Acceptance of the system in no way removes the contractor of his responsibility to make further repairs, corrections and adjustments to eliminate any deficiencies which may later be discovered

B. Cleaning and Pressure Testing:
1. Test system to the installer's satisfaction prior to requesting an official test to avoid the unnecessary presence of inspection personnel.
2. Leave uncovered all joints, ties, elbows, caps, and connections during the pressure test unless otherwise directed by the City. Main sections of solid unbroken pipe are to be buried at intervals adequate to secure stabilization of pipe runs when pressurized.
3. Flush irrigation system with water to clear lines of foreign materials after system assembly is complete and prior to installation of sprinkler heads.
4. Cap and plug outlets and fill lines with water.
5. Pressurize assembly to 125 P.S.I. and shut off pump. Monitor the system pressure at two gauge locations; the gauge locations must be at opposite ends of the main line. System shall have no pressure loss for solvent-welded pipe and not more than 3 P.S.I. with gasketed 'O' ring after two hours. If necessary, repairs leaks and retest assembly until satisfactory.
6. Upon completion of backfilling, finish grading and contouring, test the entire system for proper operation; including electrically actuating the remote control valve.

3.7 INSPECTION AND ACCEPTANCE

A. Request shall be received by the City at least five (5) days before anticipated date of inspection.

B. 100% coverage / uniform coverage is essential, add heads as needed to meet this criterion.

C. Repair / adjust heads for uniform coverage and to minimize overspray onto hardscape surfaces. Rejected plants in the season that is most favorable for resetting kinds of plants required, if possible within two week of inspection.

D. Project completion of irrigation shall constitute the beginning of guarantee period.

E. Contractor's responsibility for maintenance (exclusive of replacement within guarantee period) shall terminate on date of project completion.

END OF SECTION 328400

SECTION 329113 – SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

A. Provide labor, materials, necessary equipment and services to complete the soil preparation work, as indicated on the drawings, as specified herein or both.

B. Including, but not limited to:
1. Topsoil
2. Soil Conditioners
3. Sand1
4. Planting Soil
5. Peat

1.3 RELATED WORK

A. Section 015639 – Temporary tree and plant protection

B. Section 328400 – Planting Irrigation

C. Section 329300 – Plants

1.4 QUALITY ASSURANCE

A. Testing Agency: Independent testing laboratory

B. Conform to the requirements of Regulatory Agencies

C. Reference standards:

D. ASTM C136 - Sieve Analysis of Soils

E. ASTM D422 - Mechanical Analysis of Soils

F. ASTM D424 - Plastic Limits of Soil

1.5 SUBMITTALS

A. Contractor shall submit all component materials including and organic amendments to the appropriate laboratories as soon as possible, preferably within **90 days** after commencement of the project. The analysis and report for all tests will be submitted to the City. The Contractor shall not commence placing or stockpiling materials until the soils are approved. The Contractor

shall be responsible for the submission of all materials for testing and payment of the lab fees.

B. Test Reports:
1. Results of topsoil analysis.
2. Results of PLANT SOIL MIX C for turf sterilization analysis.
3. Results of water analysis.
4. Results of the soil analysis for the various planting soil mixes.
5. Results of “Structural Soil” analysis – including gravel and soil mix.
6. Results of subgrade tree planting/pit percolation rates.

C. Certificates:
1. Manufacturer's certification and/or testing laboratory certification that content of soil conditioners meet specification requirements.
2. Literature and proposed application rates for all Soil Amendments.
3. Literature and proposed application rates for all Herbicides and Sterilizers.
4. Qualification documentation for the fabrication of ‘Structural Soil’.

D. Samples:
1. Submit a one cubic foot sample of each planting soil mix.
2. Submit a minimum one cubic yard of turf sub grade sand.
3. Submit a minimum one cubic yard of “Structural Soil” mix.

1.6 JOB CONDITIONS

A. Protect from damage to buildings, walks, pavement, plant material, utilities, and other work or existing features.

B. Locate underground utilities and other non-readily visible structures prior to digging. Repair damage to underground utilities, and / or construction caused by utility damage.

C. Keep operational roadways, drives and pedestrian areas clean and free of obstructions. Remove dirt and debris from walkways at the end of the work day. Store and secure equipment and materials.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Use free draining topsoil, suitable for plant growth and free from hard clods, stiff clay, hardpan, gravel, subsoil, brush, roots, refuse or other deleterious material, and of uniform quality.

B. Mechanical analysis for well graded topsoil:

Sieve Size	Percentage Passing By Dry Weight
2 inch	100
1/4 inch	90-92

No. 10	50-55
No. 40	20-25
No. 100	4-6
No. 200	0-1

Dispose of materials larger than one-half inch off the site.

C. Maximum Soluble Salts: 550 ppm.

D. Acidity: pH 6.5 to pH 7.5

E. Relative Density: 25%-50%, loose

F. Relative Permeability: 8 in/hr to 14 in/hr minimum

G. Plastic Index: 3-10

2.2 SOIL CONDITIONERS

A. Aluminum Sulfate: Manufacturer's standard commercial grade.

B. Peat: Federal Specifications Q-P-166 Type 1, Class B, Sphagnum moss.

C. Pesticides: As recommended by applicable Agricultural Public Agencies.

D. Herbicides and Sterilizers:
1. “Ronstar” pre-emergent herbicide
2. “Roundup” systemic herbicide

E. Soil Amendments:
1. Fertilizer
a. All fertilizers shall be manufactured from quality materials, be free from impurities, uniform in composition meet recognized standards for effectiveness and be free flowing and suitable for application with approved equipment.
b. All fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, bearing the grade and the trade name of the producer.
c. Die Hard Root Reviver – Endo and Ectomycorrizal inoculant, as manufactured by Die hard, 1.800.628.6373 or City approved equal.
d. Die Hard Transplant – One Step – Endo and Ectomycorrizal inoculant, as manufactured by Die hard, 1.800.628.6373 or City approved equal.
e. Time release, Palm Mix fertilizer with minor elements or City approved equal.
f. Time release, Tree and Shrub Mix fertilizer, 6-6-6, with minor elements or City approved Equal.
g. Granular Triple Super Phosphate as manufactured by IMC. Agrico. 708.970.3000 or City approved equal.
h. Agriform Planting Tablets, 8-8-8 plus minors, as

manufactured by Grace Sierra, 408.263.8080 or City approved equal.

i. Scott's Turf Starter (16-25-12) or City approved equal.

j. Wetting agent to be Terra Sorb or City approved equal.

k. Soil conditioner to be "Super Lesco Wet", as manufactured by Lesco, Inc. or City Approved Equal.

2. Water: Reclaimed water or Municipal water from City of Miramar irrigation wells or municipal source.
3. Sand: Clean, sharp builders sand free draining and free of substances harmful to growth of plants.
5. Peat: Florida and Canadian Peat from City approved sources.
6. Compost: from City approved source.

2.3 PLANTING SOIL MIXES:

A. Planting Soil Mixture A to be placed in sod areas, shrub and ground cover beds and in broadleaf tree pits, both new and transplanted.
   1. 30% Topsoil, 10% Peat or Compost, 60% Sand
   2. Include soil additives such as 'DieHard' Mycorrhizal innoculant per manufacturer's recommendations.
   3. Add soil supplements per soil analysis recommendations.

B. Planting Soil Mixture B to be placed as backfill around the root balls of palms, **other than Date Palms** shall be:
   1. 70% FDOT coarse sand and 30% topsoil.
   2. Include soil additives such as 'DieHard' Mycorrhizal innoculant per manufacturer's recommendations.
   3. Add soil supplements per soil analysis recommendations.

C. Planting Soil Mixture C to be placed as backfill around the root balls of **Date** palms shall be:
   1. 80% sand, 20% Canadian Peat.
   2. Include soil additives such as 'DieHard' Mycorrhizal innoculant per manufacturer's recommendations.
   3. Add soil supplements per soil analysis recommendations.

D. Structural Soil Mix - to be placed in under walks the run adjacent to landscape / planting beds, excluding driveways and corner treatments:
   1. "Structural Soil" is a patented mixture of angular gravel, loamy soil and a hydrogel. Refer to Section 2.04 for specifics.
   2. Include soil additives such as Mycorrhizal innoculant per manufacturer's recommendations.
   3. Add additives and soil supplements per soil analysis recommendations.

E. Test pH of topsoil and planting soil mixtures. If pH is not between specified limits add approved soil conditioner/additive to bring pH within that range.

2.4 "STRUCTURAL SOIL" MATERIAL:

A. Manufacturer: Supplier shall be a licensed producer "Structural Soil", or as

approved by the City. Submit qualification documentation.

B. CU-Structural Soil™ (U.S. Patent # 5,849,069): is a two-part system comprised of a rigid stone "lattice" to meet engineering requirements for a load-bearing soil, and a quantity of soil, to meet tree requirements for root growth. The lattice of load-bearing stones provides stability as well as interconnected voids for root penetration, air and water movement

C. Gravel: A uniformly graded 3/4" to 1-1/2" angular crushed stone is specified for CU-Structural Soil.™ The gravel is designed to ensure the greatest porosity while providing structural support. Crushed or angular stone provides more compaction and structural interface of stone-to-stone than round stone. Because stone is the load-bearing component of structural soil, the aggregates used shall meet FDOT standards for pavement base courses.

D. Soil: Clay-Loam or Loam Soil. Soil shall be comprised of 20% clay to 25% clay composition. Organic matter content in the soil shall range from 2% to 5% to ensure water holding while encouraging beneficial microbial activity. A minimum of 20% clay is needed for adequate cation exchange capacity.

E. Mix: Refer to patent information or contact licensed supplier for ratios of gravel & soil in the mix. With carefully chosen uniformly-graded stone and the proper stone to soil ratio, a medium for healthy root growth is created that also can be compacted to meet engineers' load-bearing specifications for the walkways. The intention is to "suspend" the clay soil between the stones without over-filling the voids, which would compromise aeration and bearing capacity. Place mix to a depth of 24" or as show on plans. Compact Structural soil to a 95% Proctor Density or Modified Proctor Density.

F. Hydrogel Tactifier: non-toxic, non-phytotoxic tactifier.

2.5 SAND FOR TREE PITS:

A. Use free draining non-bleached sand, suitable for drainage and free from hard clods, stiff clay, hardpan, gravel, subsoil, brush, roots, refuse or other deleterious material, and of uniform quality and color.

PART 3 – EXECUTION

3.1 INSPECTION:

A. Examine areas to receive soil preparation to assure work of other trades has been completed.

B. Verify that plants to remain undisturbed have been clearly identified and protected from injury during construction. If not, identify and protect plants to remain according to procedures set forth in Section 02950 - Trees, Plants and Groundcover.

C. Remove construction materials and debris from areas to be landscaped.

D. Do not proceed with soil preparation until unsatisfactory conditions are corrected.

3.2 PERFORMANCE:

A. Placement

1. Place planting soil mixes as accepted by the City.
2. Place Planting Soil Mix A to 12" depth in shrub and ground cover beds and as backfill in broadleaf tree pits or as specified on planting details. Note: Depth of soil mix for trees should match the rootball depth (approximately 3-feet deep and, where feasible, shall extend twice the rootball diameter from the base of the tree.
3. Place soil mixes for Palms. Depth of soil mix for palms should match the rootball depth (approximately 3-feet deep and, where feasible, shall extend twice the rootball diameter from the base of the palm tree.
4. Place 'Structural Soil' under walks as shown in the plans and/or details. Under walks, compact the Structural Soil per engineering specifications and construction documentation. Place 'Structural soil' in planter beds adjacent to the sidewalks. Compaction is not necessary in landscape bed areas and tree pit areas.
5. Remove rocks and other objects over 1" in diameter. Repeat procedure in the event of disturbances to fine grading after completion.
6. To account for a 3" mulch layer, smooth Planting Soil mixture to three (3) inches below top of surrounding paving, wherever planting beds abut paved surfaces.
7. Smooth Planting Soil mixture to (1") one inch below finish grade in areas to be sodded with St. Augustine 'Floratam' sod.
8. Refer to planter cross-section typical detail for placement of soil mix in Planters.
9. Refer to pot section detail(s) for placement of soil mix in Pots.
10. Do not compact planting soil mixture, but do wet-soak planting areas to assure proper settlement. Replace topsoil/planting soil mixture to specified grade after watering.
11. Apply pre-emergent weed control per manufacturers recommended rates of application to sterilize the soil.

3.3 CLEAN-UP:

A. Immediately clean up spills, soil and conditioners on paved and finished surface areas.
B. Remove debris and excess materials from project site immediately.

END OF SECTION 329113

SECTION 329300 – PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 RELATED WORK

A. Section 02310 - Grading

B. Section 02231 - Tree Protection and Trimming

C. Section 02810 - Irrigation

D. Section 02920 - Soil Preparation

1.3 WORK INCLUDED

A. Provide labor, materials, necessary equipment and services to complete the Trees, Plants and Groundcover work, as indicated on the drawings, as specified herein or both.

1.4 QUALITY ASSURANCE

A. Reference: Grades and Standards for Nursery Plants, Florida Department of Agriculture, all volumes.

B. Inspection
   1. Furnish plant materials inspected by State Department of Agriculture at the growing site and tagged or otherwise approved for delivery by the City.
   2. Inspection at growing site does not preclude right of rejection at project site.

C. Furnish plant materials certified by State Department of Agriculture to be free from hazardous insects or disease.

D. Plant material shall meet Florida Nurserymen's standards and requirements.

1.5 SUBMITTALS

A. Certificate of inspection of plant material by State Authorities.
B. Proof of Certification of Root-Grow-Plus for Live Oak trees.

C. Proof of 'Florida Fancy' certification for Materials specified to be Florida Fancy grade.

D. Contractor shall provide a list of sources for all plant material to be approved by the City.

E. Contractor shall provide nursery stock photographs of all specified plant materials and provide any site selection of plant materials, with City/Landscape Architect, as requested by City.

F. Letter of 12 month warranty/guarantee.

G. Percolation test results for select tree pits and planters.

H. Bag tags and cut-sheets for Fertilizer, Agriform tablets, pre-emergent herbicide, Soil inoculants used.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory:
   1. Verify that species and quantity of plants matches that on plant list and drawings.
   2. Discrepancies between the provided plant list and the planting plans shall be reported to City/Landscape architect within writing prior to bid.
   3. Any discrepancies not reported shall be the responsibility of the Contractor.

B. Preparation for delivery:
   1. Prune head and / or roots of all trees as required to assure safe loading, shipment and handling without damaging the natural form and health of the plant.
   2. Balled and Burlapped (B&B) plants:
      a. Verify that all trees and palms have been root pruned not less than 8 weeks prior to digging, and not more than 16 weeks prior to digging.
      b. Dig and prepare for shipment in manner that will not damage roots, branches, shape, and future development after replanting.
      c. Ball with firm, natural balls of soil.
      d. Wrap ball firmly with burlap or strong cloth and tie: ANSI Z60.1.
      e. Provide oversized rootballs for extra ballast for street palms and street trees. Note that the rootballs will need to fit into the prescribed tree pit/holes in the sidewalk/pedestrian areas. Coordinate the sequence of work as needed.
   3. Specimen plants: Exercise care in digging, wrapping, and binding of such specimens to assure safe loading, shipment and handling to preserve specimen status.

C. Delivery:
   1. Deliver plants with legible identification labels.
      a. Label trees, evergreens, bundles or containers of like shrubs, or

groundcover plants.

b. State correct plant name and size indicated on Plant List.

c. Use durable waterproof labels with water resistant ink which will remain legible for at least 60 days.

2. Protect during delivery to prevent damage to root ball or desiccation of leaves.

3. Notify City of delivery schedule in advance so plant material may be inspected upon arrival at job site.

4. Remove unacceptable plant material immediately from job site.

5. Deliver fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to State law.

D. Storage:

1. Balled and burlapped plant stock: Deliver direct from nursery.

2. Protect roots of plant material from drying or other possible injury. Keep plant ball moist at all times.

3. Store plants in shade and protect from weather.

4. Maintain and protect plant material not to be planted within four hours.

E. Handling:

1. Do not drop plants.

2. Do not pick up container or balled plants by stems or trunks.

1.7 JOB CONDITIONS

A. Planting Season: Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice.

B. Locate underground utilities and other non-readily visible structures prior to digging. Repair damage to underground utilities, and / or construction caused by utility damage.

C. Adjust plant spacing as required to avoid damage to roots of existing trees. Notify Landscape Architect of conflicts which require field adjustment to avoid damage to existing trees.

D. Maintain identification and barricading of all existing plant material to remain throughout the installation and required maintenance period.

E. Adjust plant spacing as required as requested by City/ Landscape Architect.

1.8 GUARANTEE

A. Guarantee new plant material for a period of 12 months after date of project Completion.

B. Replacement plants under this guarantee shall be replaced within two (2) weeks of rejection and guaranteed for twelve (12) months from date of installation.

C. Repair damage to other plants, lawn or construction work during plant

replacement, including, but not limited to, damage to existing trees, walks, lattice, site furnishings, etc.

1.9 SCHEDULING

A. Install trees, shrubs, and groundcover before lawns are installed.

B. Notify the Landscape Architect of anticipated installation date at least two (2) weeks in advance.

C. Irrigation shall be 100% operational prior to the installation of plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. Well-formed and shaped, true to type, and free from disease, insects, and defects such as knots, sun-scald, windburn, injuries, abrasion or disfigurement.

B. True to botanical and common name and variety: American Joint Committee on Horticultural Nomenclature, Standardized Plant Names, latest edition.

C. Minimum grade of Florida No. 1 in accordance with “Grades and Standards for Nursery Plants” published by the State of Florida Department of Agriculture.

D. Plants not listed in “Grades and Standards for Nursery Plants” shall conform to a Florida No. 1 as to: (1) Health and vitality; (2) condition of foliage, (3) root system, (4) freedom from pest or mechanical damage, (5) heavily branched and densely foliated according to the accepted normal shape of the species or sport.

E. Nursery Grown: ANSI Z60.1
1. Grown under climatic conditions similar to those in locality of project.
2. Container grown stock:
a. Growing in container for minimum 30 days before delivery.
b. Not root bound or with root systems hardened off.
3. Use only groundcover plants well established in removable containers, integral containers, or formed homogenous soil sections.

2.2 PLANTING SOIL

A. Planting soil mixture for backfill around trees, shrubs, and groundcover shall be as specified in Section 329113 - Soil Preparation.

B. Several soil mixes shall be prepared and placed – soil for broadleaf trees and shrubs and sod. Soil mixes for Palms (and specifically for Date Palms) and ‘Structural Soil’ for street trees/palms in hardscape tree pits.

2.3 SOIL CONDITIONERS

A. Soil conditioners shall be as specified in Section 329300 - Soil Preparation.

2.4 TOP MULCH

A. Grade “A” “Florimulch” mulch – or City approved equal; shredded, loose, substantially free of mineral waste materials, viable weed seeds, and showing an acid reaction.

C. Minimum organic matter by weight on an oven dry basis: 85%.

D. Processed specifically for use as top mulch around plant beds.

2.5 GUYING AND STAKING MATERIAL

A. Stakes for tree support:
   1. Construction grade pressure treated pine, minimum nominal size 2 in. x 4 in.
   2. Brooks Adjustable Tree Bracing System or City approved equal. Model BTB-2A.

B. Nylon Strapping - black mesh, minimum 2" wide.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify final grades have been established prior to beginning planting operation.

B. Inspect trees, shrubs, and groundcover plants for injury, insect infestation, and trees and shrubs for improper pruning.
   1. Do not begin planting of trees until deficiencies are corrected, or plants replaced.
   2. Percolation tests are to be verified and accepted by the City prior to landscape installation.

3.2 LOCATION / STAKING

A. Stake out locations for plants and outline of planting beds on ground.

B. Do not begin excavation until stake out of plant locations and plant beds and tree pit locations are acceptable to the City.

C. Trees to be located and staked for inspection by the City’s Landscape Architect or the City’s Project Representative.

3.3 PREPARATION

A. Pits and trenches:

   1. Shape:
      a. Vertical sides and flat bottom.
      b. Plant pits to be square or circular.
   2. Size:

a. For trees/palms:
   (1) Depth: Minimum 2 ft. from finish grade and increased as necessary to accommodate planting ball and at least 12" planting soil backfill below ball or roots.
   (2) Width or diameter: 4 ft. greater than diameter of planting ball (unless otherwise approved by the City for special planting areas).
   (3) Prepare tree pits in sidewalk areas as shown in the plans and details.
   (4) Construct tree pits and root paths per plans and details.
b. For shrubs, 3 gallon or larger container:
   (1) Depth: As necessary to accommodate planting ball and at least 6 in. of planting soil backfill below planting ball.
   (2) Completely excavate all shrub beds to minimum depth.

B. Planting Beds - 1 gallon or smaller container:
   1. Planting beds to receive a depth of 12 in. topsoil mixture throughout.
   2. Bring beds to smooth, even surface conforming to established grades after full settlement has occurred.

C. Drainage:
   1. Ensure planters have adequate drainage. Refer to details for sub-surface drainage. Provide perforated pipe in tree pits and planters to drainage outfall. Coordinate connection with catch basin structure.
   2. Provide an augured hole in select tree pits for drainage.

D. Percolation tests:
   1. Percolation tests are to be verified by the City. Submit results to the City and to the Project Designer and Engineer of Record.
   2. Test fill tree pits with water before planting to assure proper drainage percolation is available. Pits which are found to not be adequately draining shall be excavated to a depth sufficient for drainage and backfilling with coarse sand.
   3. No allowances will be made for lost plants due to improper drainage. Replace with same species size and specification.

E. Disposal of excess soil:
   1. Use acceptable excess excavated topsoil to form watering berms around the trees and palms.
   2. Dispose of unacceptable or unused excess soil off the project site or as directed by the City.

3.4 PLANTING

A. General
   1. Irrigation shall be 100% operational prior to plant material installation.
   2. Remove burlap from top 1/2 of rootball.
   3. Center plant in pit or trench.
   4. Face for best effect, or as directed by the City.
   5. Set plant plumb and hold rigidly in position until soil has been tamped firmly around planting ball.
   6. Use only planting soil backfill as specified herein before.
   7. Place sufficient planting soil under plant to bring top of planting ball to

finish grade.

8. Backfill pit or trench with planting soil in 9 in. layers and water each layer thoroughly to settle soil and work soil completely around roots and planting ball.

9. After soil settles fill pit with planting soil, water, and leave pit surface even with finish grade.
10. Topsoil berm:
    a. Construct a topsoil berm 6 in. above finish grade forming a watering basin with a level bottom around each palm or tree.
    b. Size: 1 ft. greater than diameter of planting ball.
    c. Leave saucer for 3 months. At the end of 3 months, regrade area and re-mulch 12" out from trunk (or planting bed) for all plantings. Remove excess from basin and clean area. Replace any damaged plant material or sod.
11. Braces shall be installed, as specified herein, while the tree is supported by machinery.

B. Balled and Burlapped Plants (B & B):
1. Place in pit on planting soil backfill material that has been hand-tamped prior to placing plant.
2. Place with burlap intact so location of ground line at top of ball is same as at nursery where grown.
3. Remove binding at top half of the planting ball and cut off exposed burlap.
4. Do not pull wrapping from under planting ball.
5. Do not plant if planting ball is cracked, broken or showing evidence of voids before or during planting process. Replace with plant of same species, size, and specification.

C. Relocated Trees and Palms
1. Refer to Section 015639, Temporary tree and plant protection

D. Container-grown plants:
1. Can removal:
    a. Cut cans on two sides with an acceptable can cutter if cutting is required.
    b. Do not injure planting ball.
    c. Do not cut cans with spade or ax.
    d. Do not cut sides on knockout cans.
    e. Carefully remove plants without injury or damage to planting ball.
    f. After removing plant. Superficially cut edge roots with knife on three sides.
2. Dig planting holes to size as shown.
3. Hand place plants which are in containers less than one gallon in size.
4. Hand backfill and hand tamp leaving slight depression around bases of plants.
5. Do not cover top of root ball.
6. Water for settlement and replace required planting soil.

3.5 FERTILIZER APPLICATIONS

A. Apply at time of planting, before mulching and repeat 3 months from first fertilization. Schedule fertilization with the City.

B. All Trees, Shrubs and Palms shall be treated with the specified Agriform planting tablets. The Agriform shall be applied at a concentration and application rate as recommended by the manufacturer and approved by the City.

C. All Trees, Shrubs and Palms shall receive the specified fertilizer mix. The specified fertilizer mix shall be applied at a concentration and application rate as recommended by the manufacturer and approved by the City.

D. All Trees and Palms shall be treated with the specified endo and ectomycorrhizal transplant inoculant at the time of transplant. The specified transplant inoculant shall be applied at the concentration and application rates recommended by the manufacturer and approved by the City.

E. All Palms are to be treated with the specified Triple Super Phosphate at the time of planting. The Triple Super Phosphate shall be applied at a concentration and application rate as recommended by the manufacturer and approved by the City

F. All Trees and Palms are to be treated with the specified wetting agent, and soil conditioners at a concentration and application rate as recommended by the manufacturer and approved by the City. Soil amendments shall be mixed to produce a single fluid with each component included at the manufacturer and approved by the City. Inject into the root zone within the limits of proposed root ball at the rate of 50 gallons fluid per 1,000 square feet of tree canopy, using only approved spray equipment.

G. Water all trees, shrubs and palms immediately after fertilizer treatments, as recommended by the manufacturer, until root structure of plant is wet and fertilizer has been worked into ground. Repeat as often as necessary to assure protection from fertilizer burn.

3.6 WEED CONTROL

A. Apply pre-emergent herbicide, as approved by the Landscape Architect, per manufacturer's rate and method of application to landscape bed areas.

B. Apply pre-emergent herbicide before mulching and again as necessary throughout required maintenance period to prevent weed seed germination.

C. Do not use an herbicide or an application technique that will damage plant material. Replace, and / or repair damage to plants injured by herbicide application.

3.7 TOP MULCHING

A. Top mulch planting pits, trenches, and areas within two days after planting.

B. Cover watering basin or bed evenly with 3 inches of the specified top mulch material.

C. Water thoroughly, immediately after mulching.

D. Hose down planting area with fine spray to wash leaves of plants at least twice a week until final acceptance.

3.8 GUYING AND STAKING OF TREES

A. Stake trees as shown on the drawings.
   1. Stake installation:
      a. In landscape beds: Drive stakes perpendicularly, 3 ft. into ground at edge of root ball. Do not drive stake through root ball or soil separator or drainage gravel if present.
      b. For trees/palms in tree pits: Use Brooks Tree Bracing System or Equal. Provide 2'x4'x18" "feet" to connect to bracing legs. Set "feet" on pavers or tree grate.
      c. Paint all exposed wood bracing 'Forest Green'.
      d. Number of stakes as shown on details or, for trees in grate and large Palms, minimum of four (4) stakes shall be used.
      e. Do not connect braces directly to trunk of tree or palm. Refer to planting details for brace connections.
   2. Tying and cross-bracing:
      a. For trees over 4 in. in caliper:
         (1) Stake and tie firmly with 1 ¼" sisal strapping as shown.
      b. For trees under 4 in. in caliper:

         (1) Tie sisal strapping to vertical stakes.
   3. Support tree with machinery until bracing is complete.
   4. Maintenance: Trees and palms to remain braced continuously during duration of project.

3.9 PRUNING

A. New plant material:
   1. Prune minimum necessary to remove injured twigs and branches, deadwood, and suckers. Pruning shall be done with regard to natural form of plant material.
   2. All pruning shall conform to NAA and ISA standards.

B. Relocated plant material:
   1. Necessary pruning shall have been done prior to delivery to the site.
   2. Prune minimum necessary to remove branches and twigs injured by delivery, storage, and installation.

C. Existing plant material to remain:
   1. Prune branches and twigs of existing plants to remain so as to enhance the natural form of the plant material; remove injured branches, deadwood, and suckers; insure adequate clearance from new and proposed structures, and provide for a healthy growing state for new growth. Trim as specifically directed by the Landscape Architect in special conditions.

3.10 MAINTENANCE

A. General:

1. Begin maintenance immediately after each item is planted and continue until final inspection and acceptance.
2. Maintain a healthy growing condition by pruning, watering, cultivating, weeding, mowing, mulching, tightening, and repairing of guys, resetting plants to proper grades or upright position, restoration of plant saucer, and furnishing and applying such sprays as necessary to keep planting free of insects and diseases.
3. The root system of plants shall be watered at such intervals as will keep the surrounding soil in best condition for promotion of root growth and plant life.
4. Keep planting saucers and beds free of weeds, grass and other undesired vegetation growth.
5. Protect planting areas and plants against trespassing and damage for the duration of the maintenance period.
6. Inspect plants at least once a week and perform maintenance promptly. Replace impaired or dead plants promptly. Do not wait until near the end of the guarantee period to make replacements of plants, which have become unacceptable.
7. Remove soil ridges from around watering basins prior to end of maintenance period.

B. Watering:

1. All trees and palms to be supplied with permanent irrigation prior to the time of planting, and shall be provided with supplementary hand watering for a period of 60 days from the time of planting. The irrigation system is not designed to provide adequate water for trees and palms during the sixty day grow in period.
2. Live oaks to be provided with mist heads above canopies.
3. Shrub and groundcover beds to be supplied with water immediately upon planting and kept moist during the first two weeks after planting. After two weeks, supplement rainfall to produce a minimum of 2 inches per week. Coordinate permanent shrub and groundcover planting with permanent irrigation system installation so that system is operable prior to the time of planting.

3.11 CLEANING

A. Fill pits / depressions in holding area and rough grade to meet surrounding elevations. Remove organic or other debris resulting from the plant relocation process.

B. Sweep and wash paved surfaces.

C. Remove planting debris from project site and holding area.

3.12 INSPECTION AND ACCEPTANCE

A. Inspection of all work shall be made after ninety (90) day period of maintenance, upon written request of Contractor.

B. Request shall be received by the City at least five (5) days before anticipated date of inspection.

C. Plants that have died or are in unhealthy or badly impaired condition on inspection shall be treated or replaced.

D. If the City has reason to believe that the plants are not of the specified grade, they may request a regrading inspection by the division of plant industry, State of Florida Department of Agriculture, and such evidence will be the basis for requiring replacement of undergrade plant material.

E. Replace rejected plants in the season that is most favorable for resetting kinds of plants required, if possible within two week of inspection.

F. Project completion of landscaping shall constitute the beginning of guarantee period.

H. Contractor's responsibility for maintenance (exclusive of replacement within guarantee period) shall terminate on date of project completion.

END OF SECTION 329300

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Manholes.
3. Cleanouts.
4. Catch basins.
5. Storm-water inlets.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins and other storm-water inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following

conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two working days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager and Owner written permission.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
2. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.2 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

2.3 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 8-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness and lengths to provide depth indicated.
6. Top Section: Concentric-cone or flat-slab-top type. Top of cone shall be of a size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.6 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 8-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and grate.
8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.7 STORMWATER INLETS

A. Curb Inlets (if applicable): Made with vertical curb opening, of materials and dimensions according to FDOT standards.

B. Gutter Inlets if applicable): Made with horizontal gutter opening, of materials and dimensions according to FDOT standards. Include heavy-duty frames and grates.

C. Frames and Grates: Heavy duty, according to FDOT standards.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping at invert elevations called out on the plans.
2. Install piping with 36-inch minimum cover.
3. Install PE corrugated sewer piping according to ASTM D 2321.
4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
2. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service and other areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 by 12 inches by 6 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Make connections to existing underground structures.
1. On outside of structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

2. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction and the engineer with at least 48 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction and as directed by the engineer and the following:

a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping according to ASTM F 1417.

C. Leaks and excessive pipe deflection constitute defects that must be repaired.

D. Replace leaking and piping that is excessively deflected using new materials, and repeat visual testing until deficiencies are within tolerable allowances as determined by the engineer.

END OF SECTION 334100

SECTION 334200 - RAIN-TANK

PART 1 – GENERAL

1.1 Related Documents

A. Drawings, technical specification and general provisions of the Contract as modified herein apply to this section.

1.2 Description of Work Included

A. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the Owner's and OSHA requirements.

B. Provide and install R-Tank^{HD} System and all related products including fill materials, geotextiles, geogrids,
inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.

C. Provide and Construct the cover of the R-Tank^{HD} System including; stone backfill, structural fill cover and pavement section as specified.

D. Protect R-Tank^{HD} System from construction traffic after installation until after completion of all construction activity in the installation area.

1.3 Quality Control

A. All materials shall be manufactured in ISO certified facilities.

B. Installation Contractor shall demonstrate the following experience:
   1. A minimum of 3 R-Tank^{HD} or equivalent projects completed within 2 years; and,
   2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.
   3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.

C. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.

D. Contractor must have manufacturer's representative available for site review if requested by Owner.

1.4 Submittals

A. Submit proposed R-Tank^{HD} layout drawings. Drawings shall include typical

section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.

B. Submit manufacturer's product data, including compressive strength and unit weight.

C. Submit manufacturer's installation instructions.

D. Submit R-Tank^{HD} sample for review. Reviewed and accepted samples will be returned to the Contractor.

E. Submit material certificates for geotextile, geogrid, base course and backfill materials.

F. Submit required experience and personnel requirements as specified in Section 1.03.

1.5 Delivery, Storage, and Handling

A. Protect R-Tank^{HD} and other materials from damage during delivery and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds one week. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.

B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.

C. Cold weather:

1. Care must be taken when handling plastics when air temperature is at 40 degrees or below as plastic becomes brittle.
2. Do not use frozen materials or materials mixed or coated with ice or frost.
3. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.6 Preinstallation Conference

A. Prior to the start of the installation a preinstallation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, the R-Tank^{HD} installation contractor and the Manufacturer.

1.7 Project Conditions

A. Coordinate installation for the R-Tank^{HD} System with other on-site activities to eliminate all non-installation related construction traffic over the completed R-Tank^{HD} System. No loads heavier than the design loads shall be allowed over the system and in no case shall loads higher than a standard AASHTO H20 loads be allowed on the system at any time.

B. Protect adjacent work from damage during R-Tank^{HD} System installation.

C. All Pre-Treatment Systems to remove debris and heavy sediments must be in place and functional prior to operation of the R-Tank^{HD} System. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.

D. Contractor is responsible for any damage to the system during construction.

PART 2 – PRODUCTS

2.1 R-Tank^{HD} Units

A. R -Tank^{HD} - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height (custom for each project).

B. R-Tank^{HD} units shall meet the following Physical & Chemical Characteristics:

	Standard 4-Plate Unit	**Heavy Duty 5-Plate Unit**
Material	100% Recycled Polypropylene	
Void Area	95%	
Void Surface Area	95%	
Unit Weight	3.25 lbs / cf	3.75 lbs / cf
Service Temperature	-14 to 167 degrees Fahrenheit	
Unconfined Crush Strength	30 psi	40 psi

-Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234 (T): 800-448-3636; (F): 804-743-7779
www.acfenvironmental.com

2.2 Geosynthetics

A. Geotextile for Standard Application: A geotextile envelope is required to prevent soil material from entering R- Tank^{HD} Area. The standard geotextile shall be an 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).

B. Applications requiring water to infiltrate/exfiltrate through the geotextile as a function of the design shall utilize a woven monofilament (ACF M200 or equivalent).

C. Geogrid: Where required install Synteen SF12 or equivalent to reinforce backfill above the R-Tank^{HD} System to stiffen the subgrade when subject to design traffic loads (Geogrid is often not required for non-traffic load applications).

2.3 Structural Fill

A. Free Draining backfill shall be utilized as the bedding materials below the R-Tank^{HD} System and for backfill of the sides of the tank (Side backfill for a

minimum of 2 feet), and the initial 12 inches of material placed above the R-R-Tank^{HD} system. Structural fill is to be utilized above the R-Tank^{HD} system following the initial 12 inch lift.

B. Free Draining Backfill: Stone (smaller than 1.5" in diameter) or soil (GW, GP SW or SP as classified by the Unified Soil Classification System) can be used. Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

C. Structural Fill: Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

2.4 General

A. Utility Marker: Install metallic tape at corners of R-Tank^{HD} System to mark the area for future utility detection.

PART 3 - EXECUTION

3.1 Assembly of R-Tank^{HD} Units

A. Assembly of R-Tank^{HD}. On-site assembly of tanks shall be performed in accordance with the R-Tank^{HD} Installation Manual Section 2.

3.2 Layout and Excavation

A. Installer shall stake out, excavate and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 2 feet greater than R-Tank^{HD} dimensions in each direction allowing for installation of geotextile filter fabric, R-Tank^{HD} modules and free draining backfill materials.

B. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.

C. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades or other means until construction is complete.

D. Base of the excavation shall be smooth, level (variation of less than ½"), firm, flat and free of lumps or debris and soft or yielding subgrade areas. For standard applications, compact base to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer. For Infiltration applications, base shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration

applications. If unsuitable soils are encountered at the base, or if the base is pumping or appears excessively soft, repair the area in accordance with contract documents and as directed by the Owner's engineer.

E. Base of the excavation shall be reviewed by the Owner's Engineer prior to placement of stone. If unsuitable soils are encountered at the base, or if the base is pumping or appears excessively soft, repair the area in accordance with contract documents and as directed by the Owner's Engineer. The Owner's Engineer shall determine the required bearing capacity of the R-Tank^{HD} subgrade; however in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.

F. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.

G. Do not start installation of the R-Tank^{HD} System until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the Owner's engineer. If existing conditions are found unsatisfactory, the Owner's Engineer should be contacted for resolution prior to installation.

3.3 Preparation of Base

A. Place a thin layer (3" unless otherwise specified) of freely draining backfill materials (Section 2.03 B), over the subgrade to establish a level working platform for the R-Tank^{HD} units. Level to within ½" or as shown on the plans. Native subgrade soils may be used if determined to be stable and freely draining by the Owner's Engineer.

B. Outline the footprint of the R-Tank^{HD} System on the excavation floor using spray paint or chalk line to ensure a 2' perimeter is available around the R-Tank^{HD} System for proper installation and compaction of backfill.

3.4 Installation of the R-Tank^{HD} Units

A. Where a geotextile wrap is specified on the base of the excavation, cut strips to length and install in excavation, removing wrinkles so material lays flat. Overlap geotextile a minimum 12" or as recommended by manufacturer.

B. Where an impervious liner (for containment) is specified, install the liner per manufacturer's recommendations and the contract documents. The R-Tank^{HD} units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.

C. Install R-Tank^{HD} Units by placing side by side, in accordance with the design drawings. No lateral connections are required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the R-Tank^{HD} System. The modules are to be oriented as per the design drawing (15.75" x 28.15") with required depth as per plans. The large side plate of the

tank should be placed on the perimeter of the system. This will typically require that the two ends of the tank area will have a row of tanks placed perpendicular to all other tanks. If this is not shown in the construction drawings, it is a simple field adjustment that will have minimal effect on the overall system footprint. Refer to R-Tank^{HD} Installation Guide for more details.

D. Wrap the R-Tank^{HD} top and sides in specified geotextile. Cut strips of geotextile so that it will cover the sides and top, encapsulating the entire system to prevent soil entry into the system. Overlap geotextile 12" or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.

E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (butted up to the R-Tank^{HD}) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the R-Tank^{HD} units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against R-Tank^{HD} System.

F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 10' of each inlet & outlet connections, and with a maximum spacing of one maintenance port for every 2,500 square feet. Install all ports as noted in the R-Tank^{HD} Installation Guide.

G. Install ventilation pipes and vents as specified on drawings to provide required ventilation for proper hydraulic performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90 degree elbow with PVC pipe into a landscaped area with 'U" bend or venting bollard to inhibit the ingress of debris. A ground level concrete steel cover can be used.

3.5 Backfilling of the R-Tank^{HD} Units

A. Backfill and fill with recommended materials as follows:

1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 12". Each lift shall be placed around the entire perimeter such that each lift is no more than 24" higher than the side backfill along any other location on the perimeter of the R-Tank^{HD} System. No fill shall be placed over top of tanks until the side backfill has been completed.
2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even

when "self-compacting" backfill materials are selected, a walk behind vibratory compactor must be used

3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and R-Tank^{HD} Units.
4. No compaction equipment is permissible to operate directly on the R-Tank^{HD} Units.
5. Following placement of Side Backfill, a lift of the freely draining material (Section 2.03 B) shall be placed over the R-Tank^{HD} Units before any structural backfill is placed over the R-Tank^{HD} System.
6. Each lift of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the R-Tank^{HD} System. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 12" across the footprint of the R-Tank^{HD} System.
7. Place additional layers of geotextile and/or geogrid at elevations and extent as specified in the design details. Each layer of geosynthetic reinforcement placed above the R-Tank^{HD} System shall extend a minimum of 3 feet beyond the extent of the excavation wall.

B. Only low pressure tire or track vehicles shall be operated over the R-Tank^{HD} System during construction.
Compaction equipment shall be limited to a maximum gross vehicle weight of 6 tons. No machinery should drive on top of the tank until a minimum of 18" of backfill and compaction is achieved. "Triaxial Dump Trucks" and "Pans" shall not be operated within the R-Tank^{HD} System footprint at any time. Where necessary the heavy equipment should unload in an area adjacent to the R-Tank^{HD} System and the material should be moved over the system with tracked equipment.

C. Ensure that all unrelated construction traffic be kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the R-Tank^{HD} system until the final design section has been constructed (including pavement).

D. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

E. Backfill depth over R-Tank^{HD} System must be a minimum of 18" prior to placing compaction equipment directly above R-Tank^{HD} System. If the total backfill depth is less than 18", contact engineer or manufacturer's representative for assistance.

PART 4 – USING THE SYSTEM

4.1 Maintenance Requirements

A. A routine maintenance effort is required to ensure proper performance of the R-Tank^{HD} System. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the R-Tank^{HD} System and stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).

B. Inspection and/or Maintenance Ports in the R-Tank^{HD} System will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter. This is done by removing the cap of the port and using a measuring device long enough to reach the bottom of the R-Tank^{HD} System and stiff enough to push through the loose sediments, allowing a depth measurement.

C. If sediment has accumulated to the level noted in the R-Tank^{HD} Maintenance Guide or beyond a level acceptable to the Owner's engineer, the R-Tank^{HD} System should be flushed.

D. A flushing event consists of pumping water into the Maintenance Port and/or adjacent structure, allowing the turbulent flows through the R-Tank^{HD} System to re-suspend the fine sediments. If multiple Maintenance Ports have been installed, water should be pumped into each port to maximize flushing efficiency. Sediment-laden water can be shall be filtered through a Dirtbag^{TM} or approved equivalent if permitted by the locality.

END OF SECTION