

**COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BRUNSWICK, GA
BR-82-2001**



**COLLEGE *of*
COASTAL
GEORGIA**

**TECHNICAL SPECIFICATIONS
PERMIT SUBMITTAL
APRIL 2024**

HUSSEY GAY BELL

Established 1958

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Work phases.
 - 4. Use of premises.
 - 5. Work restrictions.
 - 6. Specification formats and conventions.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Coastal Community Center for the Arts.
 - 1. Project Location: College of Coastal Georgia, Brunswick, GA.
 - 2. Owner: Board of Regents of the University System of Georgia.
- B. Architect: Hussey, Gay, Bell, & DeYoung International, Inc.
- C. Construction Manager: McKnight Construction.
- D. Program Manager: PDC Solutions.
- E. The Work consists of the following:

Construction of a new 32,000 SF performing arts multipurpose center. The center includes a large multipurpose room with a sprung wood flooring system, retractable seating, second level balcony seating, control booth, catwalk system, and theatrical lighting and A/V systems with controls. Also included are dressing rooms and necessary back-of-house spaces. The

construction type is structural steel and metal stud framing with a combination of cast stone and EIFS exterior veneer. The roof system is steel bar joists with metal decking and lightweight insulating concrete and TPO roofing membrane.

1.4 TYPE OF CONTRACT

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

1.5 USE OF PREMISES

- A. General: Contractor shall have full use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to work in indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to phases defined on drawings.
 - 2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.

1.6 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7 a.m. to 5 p.m., Monday through Friday, except otherwise indicated.
 - 1. Weekend Hours: Coordinate with the College.
 - 2. Early Morning Hours: Coordinate with the College.
 - 3. Hours for Utility Shutdowns: Coordinate with the College.
 - 4. Hours for Noisy Activity: Coordinate with the College.
- B. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are

not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.

2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.

1.8 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within five (5) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

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

- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.

3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Submit draft of AIA Document G703 Continuation Sheets.
 3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Change Orders (numbers) that affect value.
 - e. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
 7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Progress payments shall be submitted to Architect by the 25th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit five (5) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Submittals Schedule (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building permits.

7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Certificates of insurance and insurance policies.
 9. Performance and payment bonds.
 10. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

- 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.

1.5 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or 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 required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum

clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Number of Copies: Submit five (5) opaque copies of each submittal.
4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

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

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than fifteen (15) days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

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. All 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. Preparation of Record Documents.
- l. Use of the premises and existing building.
- m. Work restrictions.
- n. Owner's occupancy requirements.
- o. Responsibility for temporary facilities and controls.
- p. Construction waste management and recycling.
- q. Parking availability.
- r. Office, work, and storage areas.
- s. Equipment deliveries and priorities.
- t. First aid.
- u. Security.
- v. Progress cleaning.
- w. Working hours.

3. Minutes: Record and distribute meeting minutes.

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

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

- a. The Contract Documents.
- b. Options.
- c. Related RFIs.
- d. Related Change Orders.
- e. Purchases.
- f. Deliveries.
- g. Submittals.
- h. Review of mockups.

- i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 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. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference 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) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
3. Minutes: Record the meeting minutes.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - 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.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.

6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow five (5) working days for Architect's response for each RFI. RFIs received 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 RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten (10) days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five (5) days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Field condition reports.
6. Special reports.

- B. Related Sections include the following:

1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

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

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

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

- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Qualification Data: For scheduling consultant.
- B. Submittals Schedule: Submit five (5) copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- C. Preliminary Construction Schedule: Submit five (5) opaque copies.

1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- D. Contractor's Construction Schedule: Submit five (5) opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- E. Daily Construction Reports: Submit three (3) copies at weekly intervals.
- F. Field Condition Reports: Submit three (3) copies at time of discovery of differing conditions.
- G. Special Reports: Submit three (3) copies at time of unusual event.

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial 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.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than one hundred twenty (120) days, unless specifically allowed by Architect.
 - 2. 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.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work under More Than One Contract: Include a separate activity for each contract.
 - 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Mockups.
 - b. Fabrication.
 - c. Sample testing.
 - d. Installation.
 - e. Tests and inspections.
 - f. Adjusting.
 - g. Curing.
 - h. Startup and placement into final use and operation.
 - 6. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.

- d. Completion of electrical installation.
 - e. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
 - F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
 - G. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven (7) days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first sixty (60) days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than fifteen (15) days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Mobilization and demobilization.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Utility interruptions.
 - f. Installation.
 - g. Work by Owner that may affect or be affected by Contractor's activities.
 - h. Testing and commissioning.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

- D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.

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

2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (refer to special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial Completions and occupancies.
 19. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one (1) day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 - 1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at 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 Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
 - 5. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 6. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
 - 9. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
- 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. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough 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 (14) fourteen 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 (14) fourteen days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow (21) twenty-one days for initial review of each submittal.
 - 5. Additional re-submittals: Architect will provide up to (2) two reviews of each submittal. For each submittal that has to be re-submitted more than once, the Contractor will be liable for the expenses of the Architect or his consultants resulting from the additional reviews.
- E. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.

- c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
- 1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number, numbered consecutively.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
 - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- 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 "No Exceptions Taken" or "Make Corrections Noted".

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

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project:

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Submit electronic submittals directly to extranet specifically established for Project.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 - 4. Submit Product Data before or concurrent with Samples.
 - 5. Number of Copies: Submit five (5) copies of Product Data, unless otherwise indicated. Architect will return three (3) copies. Mark up and retain one returned copy as a Project Record Document.

- 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 of Architect's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
 3. Number of Copies: Submit five (5) opaque (bond) copies of each submittal. Architect will return three (3) copies. Mark up and retain one returned copy as a Project Record Drawing.
- 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 appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 4. 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 (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- 5. 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 five (5) sets of Samples. Architect will retain three (3) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. 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.
4. Number of Copies: Submit five (5) copies of subcontractor list, unless otherwise indicated. Architect will return three (3) copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 1. Number of Copies: Submit five (5) copies of each submittal, unless otherwise indicated.
 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare 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.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating 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.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads.

Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

- S. **Manufacturer's Instructions:** Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- T. **Manufacturer's Field Reports:** Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- U. **Insurance Certificates and Bonds:** Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

2.3 DELEGATED DESIGN

- 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 Submittal:** In addition to Shop Drawings, Product Data, and other required submittals, submit five (5) copies of a statement, 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. 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. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Architect will review each submittal and will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 013810 – PHOTOGRAPHIC PROJECT DOCUMENTATION

PART 1 - GENERAL

- A. The Project requires comprehensive documentation of construction progress and post-inspection milestones.
- B. The Project requires that all documentation services include electronic indexing, navigation, storage and remote access to the documentation throughout the Project construction.
- C. Approved Vendor: The project documentation services described in this specification shall be provided by Multivista 4005 Wetherburn Way, Suite E, Norcross, GA 30092. Office: (678) 691-1541, www.multivista.com.

PART 2 - REQUIRED DOCUMENTATION ELEMENTS

- A. Indexing and navigation system will utilize actual AUTOCAD construction drawings, making such drawings interactive on an on-line interface. For all documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the Project.
- B. Documentation will combine indexing and navigation system with inspection-grade digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation will be accessible on-line through use of an internet connection. Documentation will allow for multiple-user access, simultaneously, on-line. Access shall be secure and accomplished through individual passwords.
- C. Construction progress for all trades will be tracked at monthly intervals (“Progressions”). Monthly progression documentation will comprehensively track both the exterior and interior construction of the building. Exterior Progressions will track 360 degrees around site and each building. Interior Progressions track all interior improvements beginning when stud work commences and continuing until Project completion.
- D. Pre-slab utilities work and site utilities will be documented post-inspection and prior to pouring slabs and/or backfilling. (Pre-slab “Exact-Built”). This process will include all underground and in-slab utilities within the building(s) envelope(s) and utility runs in the immediate vicinity of the building(s) envelope(s). This may also include utilities enclosed in slab-on-deck in multi-story buildings. Indexing and navigation accomplished through interactive site utility plans.

- E. Mechanical, Electrical, Plumbing and all other systems will be documented post-inspection and pre-insulation, sheet rock or dry wall installation. (Interior MEP “Exact Built”). This process will include all finished systems located in the walls and ceilings of all buildings at the Project. Indexing and navigation accomplished through interactive architectural plans.

- F. Miscellaneous events that occur while a shoot is being conducted, but do not fit into the building or site envelope (i.e., materials arriving on site), or events captured by the Client independently, will be dated, labeled and inserted into a Section in the navigation structure entitled “Slideshows,” allowing this information to be stored in the same “place” as the formal documentation.

- G. Project Documentation (Photo Sets)
 - 1. Monthly exterior progressions (360 degrees around the project) and slideshows (all elevations and building envelope). The slideshows allow for the inclusion of client pictures, aerial photographs, and timely images which do not fit into any regular monthly photopath.
 - 2. Regular interior progressions of all walls of the entire project to begin at time of substantial framed or as directed by the client through to completion (maximum 6 shots, per wall).
 - 3. Detailed exact built overlapping photos of all slabs just prior to placing concrete or as directed by the Permitting Authority.
 - 4. Detailed Interior exact built overlapping photos of the entire building to include documentation of all mechanical, electrical and plumbing systems in every wall and ceiling, to be conducted after rough-ins are complete, just prior to insulation and or drywall, or as directed by the Permitting Authority.
 - 5. Finished detailed Interior exact built overlapping photos of all walls, ceilings, and floors to be scheduled by client prior to owner occupancy.
 - 6. Existing Conditions survey of the existing building pad, streets, curbs, sidewalks, landscaping and exteriors of adjacent structures immediately surrounding the proposed building site with overlapping photos of the entire site. The existing conditions survey would occur just prior to the start of construction.

PART 3 - CONTRACTOR SUPPORT, COORDINATION, AND END PRODUCT

- A. Coordination of photo shoots is included in service and is accomplished through a designated representative on-site at the Project, typically and Superintendent or Project Manager. Contractor will also attend OAC or construction team meetings as necessary. Contractor's operations team will provide regular updates regarding the status of the documentation, including photo shoots concluded, the availability of new Progressions or Exact-Builts viewable on-line and anticipated future shoot dates.
- B. All on-line domain/web hosting, security measures, and redundant server back-up of the documentation are furnished.
- C. Technical support related to using the system or service is furnished.
- D. Upon completion of the Project, final copies of the documentation (the "Permanent Record") with the indexing and navigation system embedded (and active) will be provided in an electronic media format, either a DVD or external hard-drive. On-line access terminates upon delivery of the Permanent Record.

END OF SECTION 013810

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. 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 industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. 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. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: 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 uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

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

1.5 SUBMITTALS

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

- B. Reports: Prepare and submit certified written reports that 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.

- 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. 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.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications 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. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- 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 548; 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. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- 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. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, 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 seven (7) 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.
 - a. Allow seven (7) days for initial review and each re-review of each mockup.
 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.
- K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 49.

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 re-testing and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
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.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 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 factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including re-testing and re-inspecting, 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 quality-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.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within fifteen (15) days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections 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 reviewing 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 tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Re-testing and re-inspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. 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 modifications 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 - 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- 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 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 requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 3. Division 01 Section "Execution" for progress cleaning requirements.
 - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall 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. Pavement: Comply with pavement specification Sections.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, 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 and bottom rails. Provide concrete or galvanized steel bases for supporting posts.
- C. Lumber and Plywood: Comply with requirements in Division 06 Section "Rough Carpentry."
- D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- F. Paint: Comply with requirements in Division 09 painting Sections.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.

2. Conference room of sufficient size to accommodate meetings of ten (10) individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot square tack board.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of eight (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.
- 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.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with 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 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 (1) telephone line for each field office.
 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. 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 temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 3. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- G. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
1. Provide temporary, directional signs for construction personnel and visitors.
 2. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. 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.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Covered Walkway: Erect structurally adequate, protective, covered walkway for passage of individuals along adjacent public street(s). Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.
1. Construct covered walkways using scaffold or shoring framing.
 2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 3. Extend back wall beyond the structure to complete enclosure fence.
 4. Paint and maintain in a manner approved by Owner and Architect.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- K. Temporary 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.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 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.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

- B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Certified Surveys: Submit three (3) copies signed by land surveyor.
- C. Final Property Survey: Submit three (3) copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. 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, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Final Property Survey: 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.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property 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.
 - 4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. 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.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

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

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

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

- 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 operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

- 1. Inspection procedures.
- 2. Warranties.
- 3. Final cleaning.

- B. Related Sections include the following:

- 1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- 2. Division 01 Section "Execution" for progress cleaning of Project site.
- 3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- 4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- 5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

- 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
- 2. Advise Owner of pending insurance changeover requirements.
- 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.
3. Architect will provide (1) one inspection for substantial completion.
4. Contractor False Start: In the event that the Contractor request an inspection for Substantial Completion, and the Architect determines that the Contractor is not ready for inspection, it shall be deemed a false start and the Contractor shall be liable for the Architect's expenses resulting there from. They include, but are not limited to, salary, professional fees, travel expenses, and living expenses incurred by the Architect or his consultants inconvenienced by the false start.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy

of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. 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 for 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Architect will provide (1) one inspection for final completion.
3. Contractor False Start: In the event that the Contractor request an inspection for Final Completion, and the Architect determines that the Contractor is not ready for inspection, it shall be deemed a false start and the Contractor shall be liable for the Architect's expenses resulting there from. They include, but are not limited to, salary, professional fees, travel expenses, and living expenses incurred by the Architect or his consultants inconvenienced by the false start.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three (3) copies 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, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.6 WARRANTIES

A. Submittal Time: 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.

- 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, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide 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 portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo 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.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

- 1. Operation and maintenance documentation directory.
- 2. Operation manuals for systems, subsystems, and equipment.
- 3. Maintenance manuals for the care and maintenance of products, materials, and finishes and systems and equipment.

- B. Related Sections include the following:

- 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
- 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
- 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
- 4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Initial Submittal: Submit one (1) draft copy of each manual at the request of inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return and mark whether general scope and content of manual are acceptable.

- B. Final Submittal: Submit three (3) copies of each manual in final form at final inspection. Architect will return copy with comments within fifteen (15) days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit (3) three copies of each corrected manual within (15) fifteen days of receipt of Architect's comments.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

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

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

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

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

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

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one (1) set(s) of marked-up Record Prints.
 - a. Initial Submittal: Submit one (1) set(s) of marked-up Record Prints. Architect will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return plots and prints for organizing into sets, printing, binding, and final submittal.
 - b. Final Submittal: Submit one (1) set(s) of marked-up Record Prints.
- B. Record Specifications: Submit one copy (1) of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy (1) of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. 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. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

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

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
 - 2. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. Instruction Program: Submit three (3) copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit one (1) complete training manual(s) for Owner's use.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Demonstration and Training Video: Submit one (1) copy within seven (7) days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.

- d. Name of Contractor.
- e. Date video was recorded.
- f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.

2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.

5. Adjustments: Include the following:
 - a. Alignments.

- b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven (7) days' advance notice.
- C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO

- A. General: Engage a qualified commercial photographer to record demonstration and training video. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Format: Provide high definition, digital recording.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 017900

SECTION 024119 – SELECTIVE DEMOLITION

1. **SCOPE:**

Under this heading shall be included all operations necessary for demolition of the existing structures, foundations, track work and utilities as shown.

2. **PROCEDURES:**

The procedures proposed for the accomplishment of salvage and demolition work shall be submitted for review. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The submittal shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operation. The Contractor shall strictly adhere to the haul route for disposal as shown on the location plan.

3. **STRUCTURES:**

All existing structures shall be completely removed where denoted on the plans. All foundations and slabs shall be broken up and removed from the site. Sidewalks, curbs, gutters, streets and street light bases shall be completely removed. It is not anticipated that piling will be encountered under any of the structures to be removed; however, where piling are encountered they shall be removed to a point three feet below existing ground.

4. **RAILROAD TRACKS:**

All railroad tracks where shown to be removed will be coordinated with the Engineer as to its disposition. The rail, hardware and appurtenances will remain the property of the Owner. All rail, hardware and crossties that can be reused will be stockpiled at a separate location from the nonusable items. Stockpile areas are designated on the plans.

5. **DUST CONTROL:**

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

6. **DISCONNECTION OF UTILITY SERVICES:**

Utilities shall be disconnected at the points indicated. Where such disconnection will interrupt the utility services to an area not included in the Contract, arrangements for such interruption shall be reviewed with the Engineer at least 72 hours in advance of the interruption. Where water and sewer lines are disconnected or removed the remaining utility shall be plugged and left in such a manner that reconnection can be made.

7. **BURNING:**

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

8. **PROTECTION OF EXISTING WORK:**

Existing work to remain shall be protected from damage. Work damaged by the Contractor shall be repaired or restored to its original condition or acceptable equivalent.

9. EXISTING UTILITIES:

a) Utility Services.

Disconnections of utility services shall be coordinated so as not to affect service to other areas outside of the project limits. The owners of all utilities must be contacted prior to proceeding with work.

b) Utilities.

Remove or abandon all existing utilities as indicated. When utility lines are encountered that are not indicated on the drawings, they shall be removed or abandoned to the extent that they would project into or interfere with the new construction.

10. DISPOSITION OF MATERIAL:

a) Title to Materials.

Title to all materials and equipment to be demolished, except railroad trackage, track hardware, crossties to be salvaged and historical items, is vested in the Contractor upon receipt of notice to proceed. The Owner will not be responsible for the condition, loss or damage to such property after notice to proceed.

b) Material for Salvage.

Material that is salvageable will be removed from the project site by the Contractor.

c) Unsalvageable Materials.

Concrete, masonry, and other noncombustible materials, other than concrete permitted to remain in place, shall be disposed of by the Contractor off the property. Other materials such as nonuseable crossties, lumber, etc. shall be removed from the site and property of the Owner by the Contractor.

11. HISTORICAL ITEMS:

There are no known historical items on the project site; however, if historical items are discovered, remove historical items in a manner to prevent damage.

Turn over historical items, if found, to the Owner for disposition such as:

Corner Stones

Contents of Corner Stones

Document Boxes wherever located on the site.

Belgian Block

12. CLEANUP:

Remove debris and rubbish from the site as soon as practicable. Do not allow debris or rubbish to accumulate in buildings or on site. Remove and transport debris in a manner as to prevent spillage on streets or adjacent areas.

13. HAUL ROAD:

The haul roads as designated on the plans will be strictly adhered to for disposal and stockpile of material.

END OF SECTION 024119

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR 82-2001
PERMIT SUBMITTAL
APRIL 2024

024119 - 3

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
2. Section 034500 "Precast Architectural Concrete" for reinforcing used in precast architectural concrete.
3. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.
4. Section 321316 "Decorative Concrete Paving" for reinforcing related to decorative concrete pavement and walks.

1.2 PREINSTALLATION MEETINGS

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

1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent

bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For **testing and inspection agency**.

B. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

- a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, **acceptable to authorities having jurisdiction**, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, **Grade 60** deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Steel Bar Mats: ASTM A184/A184M, fabricated from **ASTM A615/A615M, Grade 60** deformed bars, assembled with clips.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, **Grade 60**, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
 - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: **ACI 318 Type 1**, same material of reinforcing bar being spliced; **tension-compression type**.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than **0.0508 inch** in diameter.

1. Finish: **Plain**.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than **1 inch**, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with **ACI 318**.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or **24 inches**, whichever is greater.
2. Stagger splices in accordance with **ACI 318**.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed **12 inches**.
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus **2 inches** for plain wire and **8 inches** for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with **ACI 117**.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a **special inspector and qualified testing and inspecting agency** to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel-reinforcement placement.
 2. Steel-reinforcement mechanical splice couplers.

3. Steel-reinforcement welding.

- D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Repair materials.
4. Concrete mixture materials.
5. Concrete mixture class types.
6. Concrete mixing.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

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

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for inspections and acceptance testing of concrete at Project site.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.

- e. Anchor rod and anchorage device installation tolerances.
- f. Cold- and hot-weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing of standard-cured and field curing of field-cured test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.
- q. Distribution of test reports.

1.4 ACTION SUBMITTALS

A. Product Data:

- 1. Portland cement.
- 2. Blended hydraulic cement.
- 3. Performance-based hydraulic cement.
- 4. Fly ash.
- 5. Slag cement.
- 6. Silica fume.
- 7. Natural or other pozzolans.
- 8. Aggregates.
- 9. Ground calcium carbonate and aggregate mineral fillers.
- 10. Admixtures:
 - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
- 11. Color pigments.
- 12. Fiber reinforcement.
- 13. Vapor retarders.
- 14. Floor and slab treatments.
- 15. Liquid floor treatments.
- 16. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 17. Joint fillers.
- 18. Repair materials.

B. Sustainable Design Submittals:

- C. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Compressive strength at 28 days or other age as specified.
 3. Compressive strength required at stages of construction.
 4. Durability exposure classes for Exposure Categories F, S, W, and C.
 5. Maximum w/cm ratio.
 6. Calculated equilibrium and fresh density for lightweight concrete.
 7. Slump or slump flow limit.
 8. Air content.
 9. Nominal maximum aggregate size.
 10. Steel-fiber reinforcement content.
 11. Synthetic microfiber content.
 12. Synthetic macrofiber content.
 13. Intended placement method.
 14. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.
- D. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- E. Samples: For **manufacturer's standard colors for color pigment vapor retarder**.
- F. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:
1. Concrete class designation.
 2. Location within Project.
 3. Exposure class designation.
 4. Formed surface finish designation and final finish.
 5. Final finish for floors.
 6. Floor treatment, if any.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.
- B. Material Certificates: For each of the following:
1. Cementitious materials.

2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following:

1. Portland cement.
2. Blended hydraulic cement.
3. Performance-based hydraulic cement.
4. Fly ash.
5. Slag cement.
6. Silica fume.
7. Natural or other pozzolans.
8. Aggregates.
9. Ground calcium carbonate and aggregate mineral filler.
10. Admixtures.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances in accordance with ACI 117 and in compliance with **ASTM E1155**.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.
 - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency,[**acceptable to authorities having jurisdiction,**] qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests on plastic concrete properties are to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with policies from ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: Cast concrete [**slab-on-ground**] [**and**] [**formed-surface**] panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship. Provide up to two batches of concrete to demonstrate the number of required mockups.
 - 1. Slab-on-Ground: Build panel in the location indicated or, if not indicated, as directed by Architect.
 - a. Divide panel into four equal panels to demonstrate saw joint cutting.
 - 2. Formed Surfaces: Build panel in the location indicated or, if not indicated, as directed by Architect.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.

- d. Seven-day compressive strength.
- e. 28-day compressive strength.
- f. Evaluation of permeability-reducing admixtures.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and **ACI 301**.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with **ACI 301** as follows:

- 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- 2. When air temperature has fallen to, or is expected to fall below **40 deg F** during the protection period, maintain delivered concrete mixture temperature within the temperature range required by **ACI 301**.
- 3. Do not use frozen materials or materials containing ice or snow.
- 4. Do not place concrete in contact with surfaces less than **35 deg F**, other than reinforcing steel.

- B. Hot-Weather Placement: Comply with **ACI 301** and **ACI 305.1**, and as follows:

- 1. Maintain concrete temperature at time of discharge to not exceed **95 deg F**.
- 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

- A. ACI Publications: Comply with **ACI 301** unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, **Type I/II, gray**.
2. Blended Hydraulic Cement: ASTM C595/C595M cement.
3. Performance-Based Hydraulic Cement: ASTM C1157/C1157M.
4. Pozzolans: ASTM C618, Class C, F, or N.
5. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
6. Ground Glass Pozzolan: ASTM C1866/C1866M, Type GS or GE.
7. Silica Fume: ASTM C1240.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, **Class 3M**
2. Maximum Coarse-Aggregate Size: **1 inch** nominal.
3. Fine Aggregate: ASTM C33/C33M.
4. Recycled Aggregate: Provide documentation of characteristics of recycled aggregate and mechanical properties and durability of proposed concrete, which incorporates recycled aggregate to conform to applicable requirements for the class of concrete.
5. Alkali-Silica Reaction: Comply with one of the following for each aggregate used:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
 - c. Alkali Content in Concrete: Not to exceed **4 lb./cu. yd.** for aggregate with expansion greater than or equal to 0.04 percent and less than 0.12 percent or **3 lb./cu. yd.** for aggregate with expansion greater than or equal to 0.12 percent and less than 0.24 percent. Test aggregate reactivity in accordance with ASTM C1293. Calculate alkali content of concrete in accordance with **ACI 301**. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

D. Lightweight Aggregate: ASTM C330/C330M, **3/4-inch** nominal maximum aggregate size.

1. Limit lightweight aggregate for internal curing to prewetted lightweight fine aggregate in accordance with ASTM C1761/C1761M.
- E. Ground Calcium Carbonate or Aggregate Mineral Filler: ASTM C1797. Unless otherwise permitted, do not use mineral filler derived from carbonate sources in concrete for members assigned to Exposure Class S1, S2, or S3.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.
- B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride **in steel-reinforced concrete**.
 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Admixtures with special properties, with documentation of claimed performance enhancement, ASTM C494/C494M, Type S.
- C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd.** when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 1. Color:
 - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
 - b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
 - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- C. Water: Potable water that does not cause staining of the surface.

2.5 ACCESSORIES

- A. Expansion- and Isolation-Joint-Filler Strips: **ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.**

- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, **epoxy resin with a Type A shore durometer hardness of 80** in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. **Types IV and V, load bearing**, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/8 inch** and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than **4100 psi** at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/4 inch** and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than **5000 psi** at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURE MATERIALS

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with **ACI 301**.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 2. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXTURE CLASS TYPES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
1. Exposure Class: **ACI 318 Class S1**.
 2. Minimum Compressive Strength: **4000 psi** at 28 days.
 3. Maximum w/cm Ratio: **0.50**.
 4. Slump Limit: **4 inches, plus or minus 1 inch** for concrete.
 5. Air Content:
 - a. Exposure Class F1: **4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.**
 6. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cementitious materials.
- B. Class B: Normal-weight concrete used for foundation walls.
1. Exposure Class: **ACI 318 Class S1**
 2. Minimum Compressive Strength: **4000 psi** at 28 days.
 3. Maximum w/cm Ratio: **0.50**.
 4. Slump Limit: **4 inches, plus or minus 1 inch** for concrete.
 5. Air Content:
 - a. Exposure Class F1: **4.5 percent, plus or minus 1.5 percent at point of**

delivery for concrete containing 1-inch nominal maximum aggregate size

6. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: **ACI 318 Class F0**.
 2. Minimum Compressive Strength: **4500 psi 28** days.
 3. Maximum w/cm Ratio : **0.45**.
 4. Slump Limit: **4 inches, plus or minus 1 inch** for concrete <Insert limits>.
 5. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 6. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.
- D. Class E: Structural lightweight concrete used for concrete toppings.
1. Exposure Class: **ACI 318 Class F0**.
 2. Minimum Compressive Strength: **3500 psi** at **28** days.
 3. Equilibrium Density: **115 lb/cu. ft.**, plus or minus **4 lb/cu. ft.** in accordance with ASTM C567/C567M.
 4. Slump Limit: **4 inches, plus or minus 1 inch** for concrete.
 5. Air Content:
 - a. Total air content must not to exceed 3 percent for concrete used in trowel-finished floors.
 6. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.
- E. Class F: Normal-weight concrete used for concrete toppings.
1. Exposure Class: **ACI 318 Class F0**.
 2. Minimum Compressive Strength: **3500 psi** at **28** days.
 3. Maximum w/cm Ratio: **0.45**.
 4. Slump Limit: **4 inches, plus or minus 1 inch** for concrete.
 5. Air Content:
 - a. Total air content must not to exceed 3 percent for concrete used in trowel-finished floors.
 6. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.
 - a. Total air content must not to exceed 3 percent for concrete used in trowel-

finished floors.

- F. Class I: Normal-weight concrete used for interior metal pan stairs and landings:
1. Exposure Class: **ACI 318 Class F0**.
 2. Minimum Compressive Strength: **3000 psi** at 28 days.
 3. Maximum w/cm Ratio: **0.45**.
 4. Maximum Size Aggregate: **1/2 inch**.
 5. Slump Limit: **3 inches**, plus **1 inch** or minus **2 inches**.
 6. Air Content: **0** percent, plus or minus 1.5 percent at point of delivery.
 7. Limit water-soluble, chloride-ion content in hardened concrete to **0.30** percent by weight of cement.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of **1 cu. yd.** or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than **1 cu. yd.**, increase mixing time by 15 seconds for each additional **1 cu. yd.**.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections,

acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

- A. Comply with **ACI 117**.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install reglets to receive waterproofing and through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with **ACI 301**.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches** into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.6 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 3. Form keyed joints as indicated. Embed keys at least **1-1/2 inches** into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls **as indicated on Drawings**. Unless otherwise

indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least **one-third** of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch**. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch** wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than **1/2 inch** or more than **1 inch** below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.7 APPLICATION OF FINISHING FLOORS AND SLABS

A. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of **1/4 inch** in one direction.
3. Apply scratch finish to surfaces [**to receive concrete floor toppings**] [**to receive mortar setting beds for bonded cementitious floor finishes**] <Insert

locations>.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with **ACI 117** tolerances for conventional concrete.
3. Apply float finish to surfaces [**to receive trowel finish**] [**and**] [**to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo**] <Insert locations>.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces [**exposed to view**] [**or**] [**to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system**] <Insert locations>.
7. Finish surfaces to the following tolerances, in accordance with **ASTM E1155**, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
 - 2) Specified overall values of flatness, FF 35; and of levelness, FL 25; with minimum local values of flatness, FF 24; and of levelness, FL 17.
 - 3) Specified overall values of flatness, FF 45; and of levelness, FL 35; with minimum local values of flatness, FF 30; and of levelness, FL 24.
 - 4) Specified overall values of flatness, FF 50; and of levelness, FL 35; with minimum local values of flatness, FF 40; and of levelness, FL 24.

b. Suspended Slabs:

- 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
 - 2) Specified overall values of flatness, FF 35; and of levelness, FL 20; with minimum local values of flatness, FF 24; and of levelness, FL 15.
 - 3) Specified overall values of flatness, FF 45; and of levelness, FL 35; with minimum local values of flatness, FF 30; and of levelness, FL 24.
- D. Trowel and Fine-Broom Finish: First apply a trowel finish to surfaces **[indicated on Drawings] [where ceramic or quarry tile is to be installed by either thickset or thinset method]**. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.
- F. Slip-Resistive Finish: Before final floating, apply slip-resistive **[aggregate] [aluminum granule]** finish to concrete stair treads, platforms, and ramps, as indicated on Drawings.
1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread **[25 lb/100 sq. ft.] <Insert rate>** of dampened slip-resistive **[aggregate] [aluminum granules]** over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive **[aggregate] [aluminum granules]**.
- G. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of **[100 lb/100 sq. ft.] <Insert rate>** unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 4. After final floating, apply a trowel finish.

5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.8 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than **1-1/2 inches** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1 inch**.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: **ACI 117**, Class D.
 - e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.
2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/4 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117**, Class B.
 - e. Locations: Apply to concrete surfaces [**exposed to public view,**] [**to receive a rubbed finish,**] [**or to be covered with a coating or covering material applied directly to concrete**] <Insert locations>.
3. ACI 301 (ACI 301M) Surface Finish SF-3.0:
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/8 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117** Class A.
 - e. Locations: Apply to concrete surfaces [**exposed to public view,**] [**to receive a rubbed finish,**] [**or to be covered with a coating or covering material applied directly to concrete**] <Insert locations>.

B. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the

rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

- d. Maintain required patterns or variances as shown on Drawings or to match **[design reference sample] [field sample panels] [mockups]**.

2. Grout-Cleaned Rubbed Finish:

- a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
- b. Do not clean concrete surfaces as Work progresses.
- c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
- d. Wet concrete surfaces.
- e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
- f. Maintain required patterns or variances as shown on Drawings or to match **[design reference sample] [field sample panels] [mockups]**.

C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Perform abrasive blasting after compressive strength of concrete exceeds **2000 psi**.
2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
3. Surface Continuity:
 - a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match **[design reference sample] [field sample panels] [mockups]**.
4. Abrasive Blasting:
 - a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
 - b. Determine type of nozzle pressure and blasting techniques required to match field sample.
 - c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Brush Texture: Remove cement matrix to dull surface sheen and expose face of fine aggregate, with no significant reveal.
 - 2) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases [4 inches] [6 inches] [8 inches] <Insert dimension> high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert value> at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with **ACI 301** for cold weather protection during curing.
2. Comply with **ACI 301** and **ACI 305.1** for hot-weather protection during curing.
3. Maintain moisture loss no more than **0.2 lb/sq. ft. x h**, calculated in accordance with ACI 305R, before and during finishing operations.

B. Curing Formed Surfaces: Comply with **ACI 308.1** as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with **ACI 308.1** as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with

moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive.

- a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
- a) Water.
 - b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than

- 12 inches.**
- b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
- a) Water.
 - b) Continuous water-fog spray.
- d. Floors To Receive Chemical Stain:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors To Receive Urethane Flooring:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped **6 inches** and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors To Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period.
 - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
- g. Floors To Receive Curing and Sealing Compound:
- 1) Apply uniformly to floors and slabs indicated in a continuous

operation by power spray or roller in accordance with manufacturer's written instructions.

- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least **[one] [six]** month(s).
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a **No. 16** sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of **0.01 inch** spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** in any dimension to solid concrete.
 - a. Limit cut depth to **3/4 inch**.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and match surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of **0.01 inch** wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of **1/4 inch** to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes **1 inch** or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel

- reinforcement with at least a **3/4-inch** clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes **1 inch** or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: **Owner will engage** a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
 - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and **ACI 301**, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.

- 4) Name of concrete manufacturer.
- 5) Date and time of inspection, sampling, and field testing.
- 6) Date and time of concrete placement.
- 7) Location in Work of concrete represented by samples.
- 8) Date and time sample was obtained.
- 9) Truck and batch ticket numbers.
- 10) Design compressive strength at 28 days.
- 11) Concrete mixture designation, proportions, and materials.
- 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
- 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
- 14) Type of fracture and compressive break strengths at seven days and 28 days.

4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.

C. Delivery Tickets: comply with ASTM C94/C94M.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding **5 cu. yd.**, but less than **25 cu. yd.**, plus one set for each additional **150 cu. yd.** or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
 - a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
3. Slump Flow: ASTM C1611/C1611M:

- a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; **ASTM C173/C173M volumetric method, for structural lightweight concrete.**
- a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:
- a. One test hourly when air temperature is **40 deg F** and below or **80 deg F** and above, and one test for each composite sample when strength test specimens are cast.
6. Concrete Density: ASTM C138/C138M:
- a. One test for each composite sample when strength test specimens are cast.
7. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.
- a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.³.
8. Compression Test Specimens: ASTM C31/C31M:
- a. Cast and standard cure two sets of [**two**] [**three**] [**four**] **6 inches** by **12-inches** or **4-inch** by **8-inch** cylindrical specimens for each composite sample.
 - b. Cast, and field cure [**two**] **<Insert number>** sets of [**two**] [**three**] [**four**] standard cylindrical specimens for each composite sample.
9. Compressive-Strength Tests: ASTM C39/C39M.
- a. Test one set of [**two**] [**three**] [**four**] standard cured specimens at seven days and one set of two specimens at 28 [**other age**] days.
 - b. Test one set of [**two**] [**three**] [**four**] field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide

- corrective procedures for protecting and curing in-place concrete.
11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than **500 psi** if specified compressive strength is **5000 psi**, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than **5000 psi**.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with **ACI 301**, Section 1.7.6.3.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with **ASTM E1155** within **[24] [48] [72] <Insert number>** hours of completion of floor finishing and promptly report test results to Architect.

3.14 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION 033000

SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 DEFINITIONS

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
- C. Shop Drawings:
 - 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 - 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate separate face and backup mixture locations and thicknesses.
 - 5. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 8. Include and locate openings larger than **10 inches**. Where additional structural support is required, include header design.
 - 9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 10. Indicate relationship of precast structural concrete units to adjacent materials.

11. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.
12. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
13. Indicate estimated camber for precast floor slabs with concrete toppings.
14. Indicate shim sizes and grouting sequence.
15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Samples:

1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of three, representative of finish, color, and texture variations expected; approximately **12 by 12 by 2 inches**.
 - a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

E. Delegated Design Submittals: For precast structural concrete 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. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **Installer, fabricator, and testing agency**.

B. Welding certificates.

C. Material Certificates: For the following:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Insulation.
6. Structural-steel shapes and hollow structural sections.
7. Thin-brick units and accessories.
8. Stone anchors and accessories.

D. Material Test Reports: For aggregates, by a qualified testing agency.

- E. Preconstruction test reports.
- F. Source quality-control reports.
- G. Field quality-control **and special inspection** reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Designated as a PCI-certified plant as follows:
 - a. Group CA, **Category C3A - Prestressed Straight-Strand Structural Members, Category C4A - Prestressed Deflected-Strand Structural Members.**
- B. Required Certified Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect **Category S2 – Complex Structural Systems.**
- C. Installer Qualifications: An experienced precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in **Category S2 - Complex Structural Systems** and who can produce an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."
- D. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
- E. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."
- G. Sample Panels: After sample approval and before fabricating precast structural concrete units with **architectural finish**, produce a minimum of **two** sample panels approximately **16 sq. ft.** in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 - 1. Locate panels where indicated or, if not indicated, as directed by Architect.
 - 2. Damage part of an exposed-face surface for each finish, color, and texture, and

demonstrate adequacy of repair techniques proposed for repair of surface blemishes.

3. After approval of repair technique, maintain one sample panel at fabricator's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
4. Demolish and remove sample panels when directed.

1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 2. Place adequate dunnage of even thickness between each unit.
 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast structural concrete units.
- B. Design Standards: Comply with **ACI 318** and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets prescriptive requirements of authorities having jurisdiction or has been calculated according to **ACI 216.1** and is acceptable to

authorities having jurisdiction.

D. Structural Performance:

1. Precast structural concrete units and connections to withstand design loads indicated within limits and under conditions indicated.
2. Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - a. Dead Loads: 10 psf (in addition to self-weight)
 - b. Live Loads: 100 psf (unreducible)
 - c. Seismic Loads: See General Structural Notes
 - d. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of **ACI 318**.
 - 1) Thermal Movements: Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
 - e. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration [**indicated**] [**to match those used for precast concrete design reference sample**]. Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, **Grade 60**, deformed.

- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Steel Bar Mats: ASTM A184/A184M, fabricated from **ASTM A615/A615M, Grade 60**, deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from **as-drawn steel** wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M or ASTM A1064/A1064M, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

- A. Pretensioning Strand: **ASTM A416/A416M, Grade 250 or Grade 270, uncoated, seven-wire or ASTM A886/A886M, Grade 270, indented, seven-wire**, low-relaxation strand.
- B. Unbonded Post-Tensioning Strand: ASTM A416/A416M, **Grade 270**, uncoated, seven-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.
- C. Post-Tensioning Bars: ASTM A722/A722M, uncoated high-strength steel bar.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Pozzolans: ASTM C618, Class C, F, or N with maximum loss on ignition of 3 percent.
 - 2. Metakaolin: ASTM C618, Class N.
 - 3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with **Class 5M**. Stockpile fine and coarse

aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: **Uniformly graded.**
 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate to match approved finish sample.
- D. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C330/C330M, with absorption less than 11 percent.
- E. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- G. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 4. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
 5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 7. Plasticizing Admixture: ASTM C494/C494M, Type S.
 8. Plasticizing and Retarding Admixture: ASTM C494/C494M, Type S.
 9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.
- B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.
- D. Malleable-Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

- E. Carbon-Steel Castings: ASTM A27/A27M, **Grade 60-30**.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.
- G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, **Grade 65**.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: **ASTM A307, Grade A**; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563/A563M; and flat, unhardened steel washers, ASTM F844.
- K. High-Strength Bolts, Nuts, and Washers:
 - 1. ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: **Plain**.
 - 2. ASTM F3125/F3125M, **Grade A490**, Type 1, heavy-hex steel structural bolts; ASTM A563/A563M heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply [**lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79**] [**SSPC-Paint 25**] according to SSPC-PA 1.
- M. Welding Electrodes: Comply with AWS standards.
- N. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 STAINLESS STEEL CONNECTION MATERIALS

- A. Stainless Steel Plate: ASTM A240/A240M or ASTM A666, Type 304, Type 316, or Type 201.
- B. Stainless Steel Bolts and Studs: **ASTM F593, Alloy Group 1 or 2**, hex-head bolts and studs; **ASTM F594, Alloy Group 1 or 2** stainless steel nuts; and flat, stainless steel washers.
 - 1. Lubricate threaded parts of stainless steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless Steel-Headed Studs: ASTM A276/A276M, Alloy 304 or 316, with minimum

mechanical properties of PCI MNL 116.

2.8 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units[**as recommended by precast fabricator for application**]:
1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D2240; minimum tensile strength **2250 psi**, ASTM D412.
 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D2240; capable of supporting a compressive stress of **3000 psi** with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.9 ACCESSORIES

- A. Reglets Specified Elsewhere: Specified in Section 076200 "Sheet Metal Flashing and Trim."
- B. Reglets: [**PVC extrusions**,] [**Stainless steel, Type 302 or Type 304**,] [**Copper**,] felt or fiber filled, or with face opening of slots covered.
- C. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.10 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade

A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.11 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
 - 2. Limit use of fly ash to **20** percent replacement of portland cement by weight and ground granulated blast-furnace slag to **20** percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by **ACI 318** or PCI MNL 116 when tested according to ASTM C1218/C1218M.
- D. Normal-Weight Concrete Mixtures: Proportion **full-depth mixture** by either laboratory trial batch or field test data methods according to ACI PRC-211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): **5000 psi**.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.12 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly [**chamfered**] [**radiused**].

2.13 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than **10 inches** in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement

- during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel and prestressing strand to maintain at least **3/4-inch** minimum concrete cover. Increase cover requirements for reinforcing steel to **1-1/2 inches** when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 5. Protect strand ends and anchorages with a minimum of **1-inch-** thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of **1 inch** or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.14 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.
- B. Thin-Brick-Faced Precast Structural Concrete Units: Restrict the following misalignments to 2 percent of number of thin bricks in a unit:
 1. Alignment of Mortar Joints:
 - a. Jog in Alignment: **1/8 inch.**
 - b. Alignment with Panel Centerline: Plus or minus **1/8 inch.**
 2. Variation in Width of Exposed Mortar Joints: Plus or minus **1/8 inch.**
 3. Tipping of Individual Thin Bricks from the Panel Plane of Exposed Thin-Brick Surface: Plus **0 inch**; minus **1/4 inch** less than or equal to depth of form-liner joint.
 4. Exposed Thin-Brick Surface Parallel to Primary Control Surface of Panel: Plus **1/4 inch**; minus **1/8 inch.**
 5. Individual Thin-Brick Step in Face from Panel Plane of Exposed Thin-Brick Surface: Plus **0 inch**; minus **1/4 inch** less than or equal to depth of form-liner joint.
- C. Stone Veneer-Faced Precast Structural Concrete Units:
 1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus **1/4 inch.**

2. Variation in Joint Width: **1/8 inch in 36 inches** or a quarter of nominal joint width, whichever is less.
3. Variation in Plane between Adjacent Stone Units (Lipping): **1/16-inch** difference between planes of adjacent units.

2.15 COMMERCIAL FINISHES

- A. Commercial Grade: Remove fins and protrusions larger than **1/8 inch** and fill holes larger than **1/2 inch**. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to **3/16 inch**.
- B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than **1/2 inch** caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than **1/4 inch** in width that occur more than once per **2 sq. in.** Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to **1/8 inch**.
- C. Grade B Finish: Fill air pockets and holes larger than **1/4 inch** in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than **1/8 inch** in width that occur more than once per **2 sq. in.** Grind smooth form offsets or fins larger than **1/8 inch**. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.
- D. Grade A Finish: Repair surface blemishes and fill air holes with the exception of air holes **1/16 inch** in width or smaller, and form marks where the surface deviation is less than **1/16 inch**. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
- E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- G. Apply roughened surface finish according to **ACI 318** to precast concrete units that receive concrete topping after installation.

2.16 COMMERCIAL ARCHITECTURAL FINISHES

- A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform and straight. Finish exposed-face surfaces of precast concrete units to match approved [**design reference sample**] [**sample panels**] [**mockups**] and as follows:

1. Design Reference Sample: <Insert description and identify fabricator and code number of sample>.
2. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
3. As-Cast-Surface Finish: Provide surfaces to match approved sample or mockup for acceptable surface, air voids, sand streaks, and honeycomb.
4. Textured-Surface Finish: Impart by form liners or inserts.
5. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
6. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete molds and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
7. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
8. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attack.
9. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
11. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.
12. Thin-Brick Facing: See "Thin-Brick Facings" Article.
13. Stone Facing: See "Stone Facings" Article.

2.17 SOURCE QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.
 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units is considered deficient if units fail to comply with **ACI 318** requirements for concrete strength.
- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with **ACI 318** requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42/C42M.

1. A minimum of three representative cores to be taken from units of suspect strength, from locations directed by Architect.
 2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
 3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum **4.0-mil**- thick coat of galvanized repair paint to galvanized surfaces according to ASTM A780/A780M.
 - 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 - 4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding

- connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
 - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
 - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
 - c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
 - d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
 3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: **Owner will engage** a qualified special inspector to perform the following special inspections:
 1. Erection of precast structural concrete members.
- B. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and

ASTM E1444. High-strength bolted connections are subject to inspections.

- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of **20 ft.**
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

SECTION 042000 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Miscellaneous masonry accessories.
- B. Related Sections include the following:
 - 1. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
 - 2. Division 7 Section "Through-Penetration Firestop Systems" for firestopping at openings in masonry walls.
 - 3. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistive joint systems at heads of masonry walls.
 - 4. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
 - 5. Division 8 Section "Louvers" for wall vents (brick vents).
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
 - 2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 7 Section "Sheet Metal Flashing and Trim."

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops a net-area compressive strengths (f_m) of 1900 psi at 28 days.
- B. Determine net-area compressive strength (f_m) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced CMU walls with all reinforcement shown including bond beams, opening reinforcing, etc. and control joints.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
 - 1. Accessories embedded in masonry.
- D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, per ASTM C 780 for mortar mixes required to comply with property specification.
 - 2. Include test reports, per ASTM C 1019 for grout mixes required to comply with compressive strength requirement.

- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- G. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Coordinate Construction with Special Inspector.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on

elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

- 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 construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where 1 wythe of multiwythe 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.
- B. 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.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bull-nose units for outside corners in interior spaces, unless otherwise indicated.
 - a. Provide square-edge units at the first course at floor level and bull-nose units for each course above the first.
- B. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Weight Classification: Lightweight.
 - 3. Size (Width): As indicated on drawings. Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.4 CONCRETE AND MASONRY LINTELS

- A. General: Provide concrete complying with requirements below.
- B. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated. Cure precast lintels by same method used for concrete masonry units. Use Lott's Concrete lintels or equal.

- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from U shaped block with bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: ASTM C 91.
 - 1. Products:
 - a. Lafarge North America Inc.; Magnolia Masonry Cement or Lafarge Masonry Cement.
 - b. Cemex.
 - c. Old Castle.
- E. Mortar Cement: ASTM C 1329.
 - 1. Products:
 - a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
 - b. Cemex.
 - c. Old Castle.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Products:
 - a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
 - b. Davis Colors; True Tone Mortar Colors.
 - c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
 - d. Cemex.
- G. Colored Cement Product: Packaged blend made from portland cement and lime masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
4. Available Products:
 - a. Colored Portland Cement-Lime Mix:
 - 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
 - 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) Lafarge North America Inc.; Eaglebond.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - 5) Cemex.
 - b. Colored Masonry Cement:
 - 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Essroc, Italcementi Group; Brixment-in-Color.
 - 3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 4) Lafarge North America Inc.; Magnolia Masonry Cement.
 - 5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 6) National Cement Company, Inc.; Coosa Masonry Cement.
 - 7) Cemex.
 - c. Colored Mortar Cement:
 - 1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.
 - 2) Cemex.
 - 3) Old Castle.

H. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C 404.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Products:
 - a. Addiment Incorporated; Mortar Kick.
 - b. Euclid Chemical Company (The); Accelguard 80.

- c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
 - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
- 1. Products:
 - a. Addiment Incorporated; Mortar Tite.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.
- L. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
- 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter.
 - 4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 - 5. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.
- C. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- D. Postinstalled Anchors: Provide chemical or torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. 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).

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type S.
- D. Pigmented Mortar: Use colored cement product.
 1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 3. Custom color to match Architect's sample.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 1. Custom color to match Architect's sample.

- F. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 10 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.

- F. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. 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.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated. Brace non-load bearing partitions per the drawings.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
 - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

- A. Lay concrete masonry units as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.

3.7 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042000

SECTION 047200 - CAST STONE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cast stone trim, custom sizes as indicated on drawings, including the following:
 - a. Water tables.
 - b. Unit masonry.
 - c. Trim Pieces
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry Assemblies" for brick and CMU.

1.3 DEFINITIONS

- A. Cast Stone: Architectural precast concrete building units intended to simulate natural cut stone.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.
 - 2. Show layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation.
 - 3. Show joints, including expansion joints ("soft" type) and grouted joints ("rigid" type).
 - 4. Show location and details of anchorage devices that are to be embedded in other construction.
- C. Samples for Initial Selection: For colored mortar.

- D. Samples for Verification:
 - 1. For each color and texture of cast stone required, 10 inches square in size.
 - 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used.
- E. Mockup Samples: Furnish sample units for each color and texture of cast stone required for installation in mockups.
- F. Full-Size Samples: For each type of cast stone unit required.
 - 1. Make available for Architect's review at Project site.
 - 2. Approved Samples may be installed in the Work.
- G. Qualification Data: For manufacturer.
 - 1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- H. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
 - 1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units.
- B. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. See Specification Section 042000.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store installation materials on elevated platforms, under cover, and in a dry location.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but not less than 7 days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Do not use admixtures unless specified or approved in writing by Architect.
 - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - 3. Air-Entraining Admixture: ASTM C 260.
 - 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
 - 1. Galvanized Coating: ASTM A 767/A 767M.
- H. Embedded Anchors and Other Inserts: Steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

2.3 CAST STONE UNITS

- A. Manufacturers:
 - 1. Arriscraft International.
 - 2. Continental Cast Stone
 - 3. BASSCO
 - 4. Haddon Stone
- B. Provide cast stone units complying with ASTM C 1364 using the vibrant dry tamp or wet-cast method.
 - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp edges unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements, unless otherwise indicated.
- D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- E. Cure units by one of the following methods:
1. Cure units with steam in enclosed curing room at temperature of 105 deg F or above and 95 to 100 percent relative humidity for 6 hours.
 2. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 hours.
- F. Acid-etch units after curing to remove cement film from surfaces to be exposed to view.
- G. Colors and Textures: Custom color to match existing City Hall Building. Smooth face.

2.4 MORTAR MATERIALS

- A. Provide mortar materials that comply with Division 4 Section "Unit Masonry Assemblies."

2.5 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.
- B. Dowels: Round steel bars complying with ASTM A 36/A 36M or ASTM A 615/A 615M, 1/2-inch diameter, and hot-dip galvanized to comply with ASTM A 123/A 123M.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
1. Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.6 MORTAR MIXES

- A. Comply with requirements in Division 4 Section "Unit Masonry Assemblies" for mortar mixes.
- B. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- C. Comply with ASTM C 270, Proportion Specification.
 - 1. For setting mortar, use Type S.
 - 2. For pointing mortar, use Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 - 3. Mix to match Architect's sample.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of cast stone.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Division 4 Section "Unit Masonry Assemblies."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.

- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints, unless otherwise indicated.
 - 1. Build anchors and ties into mortar joints as units are set.
 - 2. Fill dowel holes and anchor slots with mortar.
 - 3. Fill collar joints solid as units are set.
 - 4. Build concealed flashing into mortar joints as units are set.
 - 5. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
 - 6. Keep joints at shelf angles open to receive sealant.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated. Keep joints free of mortar and other rigid materials.
 - 1. Form open joint of width indicated, but not less than 3/8 inch.
- G. Prepare joints indicated to receive sealant and apply sealant of type and at locations indicated to comply with applicable requirements in Division 7 Section "Joint Sealants."
 - 1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant, unless otherwise indicated.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20.
 - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Structural-steel materials.
 2. Shrinkage-resistant grout.
 3. Shear stud connectors.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A6/A6M with flanges thicker than **1-1/2 inches**.
 2. Welded built-up members with plates thicker than **2 inches**.
 3. Column base plates thicker than **2 inches**.
- D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Slide bearings.
8. Shop primer.
9. Galvanized-steel primer.
10. Etching cleaner.
11. Galvanized repair paint.
12. Shrinkage-resistant grout.

- B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

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

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint **whether prequalified or qualified by testing**, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

- E. Delegated Design Submittal: For structural-steel connections indicated on Drawings to

comply with design loads, include analysis data **signed and sealed by the qualified professional engineer responsible for their preparation.**

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **Installer, fabricator, professional engineer, and testing agency.**
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, **Category ACSE.**
- C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint [**Endorsement P1**] [**Endorsement P2**] [**Endorsement P3**] or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as

required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
 - a. Use **Allowable Stress Design; data are given at service-load level.**
- C. Moment Connections: **Type FR, fully restrained.**
- D. Construction: **Combined system of moment frame and braced frame.**

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: **ASTM A992/A992M**.
- B. Channels, Angles, M-Shapes: **ASTM A36/A36M**
- C. Channels, Angles, S-Shapes: **ASTM A36/A36M**.
- D. Plate and Bar: **ASTM A572/A572M, Grade 50**.
- E. Cold-Formed Hollow Structural Sections: **ASTM A500/A500M, Grade C** structural tubing.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 - 1. Weight Class: As indicated.
 - 2. Finish: **Black except where indicated to be galvanized**.
- G. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- H. Steel Forgings: ASTM A668/A668M.
- I. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, **Type 325-1**, compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A490**, Type 1, heavy-hex steel structural bolts **or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends**; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, **Type 490-1**, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: **Hot-dip zinc coating**.
 2. Direct-Tension Indicators: ASTM F959/F959M, **Type 325-1**, compressible-washer type with **mechanically deposited zinc coating** finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, **heavy-hex** or **round** head assemblies, consisting of steel structural bolts with splined ends; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
1. Finish: **Plain**.
- E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: **ASTM F1554, Grade 55, weldable**.
1. Configuration: **Straight**.
 2. Nuts: **ASTM A563 heavy-hex** carbon steel.
 3. Plate Washers: ASTM A36/A36M carbon steel.
 4. Washers: **ASTM F436**, Type 1, hardened carbon steel.
 5. Finish: **Plain**.
- B. Headed Anchor Rods: **ASTM F1554, Grade 55, weldable**, straight.
1. Nuts: **ASTM A563 heavy-hex** carbon steel.
 2. Plate Washers: ASTM A36/A36M carbon steel.
 3. Washers: **ASTM F436**, Type 1, hardened carbon steel.
 4. Finish: **Plain**.
- C. Threaded Rods: **ASTM A36/A36M**.
1. Nuts: **ASTM A63 heavy-hex** carbon steel.
 2. Washers: **ASTM F436, Type 1** carbon steel.
 3. Finish: **Plain**.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

A. Steel Primer:

1. Comply with [Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]
[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."]
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: [MPI#26] [MPI#80,] [MPI#134].

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: [MPI#18, MPI#19, or SSPC-Paint 20] [ASTM A780/A780M].

2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, [**mechanically thermal cut,**] or punch standard bolt holes perpendicular to metal surfaces.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with [SSPC-SP 1.] [SSPC-SP 2.] [SSPC-SP 3.]
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than **10 inches** o.c. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. **Do not thermally cut bolt holes or enlarge holes by burning.**
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: **Pretensioned (provide Class A surface preparation at all bolted connections for vertical frames (braced or moment)).**
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize **lintels, shelf angles, and welded door frames** attached to structural-steel frame and located in exterior walls.

2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches**.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces **unless indicated to be painted**.
 6. Corrosion-resisting (weathering) steel surfaces.
 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 2.
 2. SSPC-SP 3.
 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 4. SSPC-SP 14 (WAB)/NACE WAB-8.
 5. SSPC-SP 11.
 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 8. SSPC-SP 5 (WAB)/NACE WAB-1.
 9. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect **and test** shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. **Snug-tighten** anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. **Comply with manufacturer's written installation instructions for grouting.**
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection **unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.**
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that

must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: **Pretensioned**.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs **where indicated**, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in [**Section 099113 "Exterior Painting."**] [**Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect **and test** bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. DLH-series long-span steel joists.
3. Steel joist accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **manufacturer** and **professional engineer**.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Mill Certificates: For each type of bolt.
- F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- G. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.
 - 1. Use **ASD; data are given at service-load level**.
 - 2. Design special joists to withstand design loads with live-load deflections no

greater than the following:

- a. Roof Joists: Vertical deflection of **1/360** of the span.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: **K-series steel joists.**
2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
3. Provide holes in chord members for connecting and securing other construction to joists.
4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
6. Do not camber joists.
7. Camber joists **according to SJI's "Specifications."**
8. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches.**

- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements **as follows:**

1. Joist Type: **DLH-series long-span steel joists.**
2. End Arrangement: **Underslung.**
3. Top-Chord Arrangement: **Parallel.**
4. Provide holes in chord members for connecting and securing other construction to joists.
5. Camber long-span steel joists **according to SJI's "Specifications."**
6. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds **1/4 inch per 12 inches.**

2.3 PRIMERS

- A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
2. Provide shop primer that complies with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**

2.4 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of **horizontal or diagonal** bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: **Plain**.

C. Welding Electrodes: Comply with AWS standards.

D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by [**hand-tool cleaning, SSPC-SP 2**] [or] [**power-tool cleaning, SSPC-SP 3**].

B. Do not prime paint joists and accessories[**to receive sprayed fire-resistive materials**].

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than **1 mil** thick.

D. Shop priming of joists and joist accessories is specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**]

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications, joist manufacturer's written instructions, and requirements in this Section."
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel **framework**. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:
 - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists **abutting structural steel**, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.
 - 2. Cleaning and touchup painting are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-**

Performance Coatings."]

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ACTION SUBMITTALS

- A. Product Data:

1. Roof deck.
2. Composite floor deck.

- B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Product Certificates: For each type of steel deck.

- C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

- D. Field Quality-Control Submittals:

1. Field quality-control reports.

- E. Qualification Statements: For **welding personnel and testing agency**.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
 2. AWS D1.3/D1.3M.
- B. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and **[Class 1-60] [Class 1-75] [Class 1-90]** windstorm ratings. Identify materials with FM Approvals Certification markings.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, **No. 12** minimum diameter.

- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of **33,000 psi**, not less than **0.0359-inch** design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of **33,000 psi**, of same material and finish as deck, and of thickness and profile **recommended by SDI standards for overhang and slab depth**.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, **0.0747 inch** thick, with factory-punched hole of **3/8-inch** minimum diameter.
- J. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- K. Flat Sump Plates: Single-piece steel sheet, **0.0747 inch** thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Recessed Sump Pans: Single-piece steel sheet, **0.0747 inch** thick, of same material and finish as deck, with **3-inch-** wide flanges and **sloped** recessed pans of **1-1/2-inch** minimum depth. For drains, cut holes in the field.
- M. Galvanizing Repair Paint: [**ASTM A780/A780M**] [**SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight**].
- N. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.
- J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: **3/4 inch**, nominal.
 - 2. Weld Spacing:
 - a. Weld edge ribs of panels at each support. Space additional welds an average of **16 inches** apart, but not more than **18 inches** apart.
 - b. Space and locate welds as indicated.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or **12 inches**, and as follows:
 - 1. Mechanically fasten with self-drilling, **No. 12** diameter or larger, carbon-steel

- screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of **1-1/2-inch-** long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **1-1/2 inches**, with end joints as follows:
- 1. End Joints: **Lapped or butted at Contractor's option.**
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at [**14 inches**] <Insert dimension> apart in both directions, within **9 inches** of walls at ends, and not more than **12 inches** from walls at sides unless otherwise indicated.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting:
- 1. Wire brush and clean rust spots, welds, and abraded areas on **both surfaces** of prime-painted deck immediately after installation, and apply repair paint.
 - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
- 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection

requirements of SDI QA/QC.

- a. Field welds will be subject to inspection.
2. Steel decking will be considered defective if it does not pass tests and inspections.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION 053100

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 and guards attached to metal stairs.
3. **Steel tube** handrails attached to walls adjacent to metal stairs.
4. Railing gates at the level of exit discharge.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, **railings, and guards**.
1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, **blocking for attachment of wall-mounted handrails**, and items with integral anchors, that are to be embedded in concrete or masonry.
 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Perforated metal.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Prefilled metal-pan-stair treads.
5. Abrasive nosings.

6. Shop primer products.
7. Nonslip-aggregate concrete finish.
8. Abrasive-coating finish to formed-metal stairs.
9. Handrail wall brackets.
10. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

- C. Delegated Design Submittal: For stairs, **railings and guards** including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the **State** in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure in a manner that might cause distortion,

damage, or overload to members or supporting structures.

- a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, **railings and guards**, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs 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 and guard loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to **L/360** or **1/4 inch**, whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, 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.
 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - a. Temperature Change: Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- D. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. Component Importance Factor: 1.0.

2.2 METALS

- A. Metal Surfaces: 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. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing for Railings and Guards: **ASTM A500/A500M (cold formed) or ASTM A513/A513M.**
 1. Provide galvanized finish for exterior installations and where indicated.
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 1. Provide galvanized finish for exterior installations and where indicated.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, **either commercial steel, Type B, or structural steel, Grade 25,** unless another grade is required by design loads; exposed.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, **either commercial steel, Type B, or structural steel, Grade 30,** unless another grade is required by design loads.
- G. Galvanized Steel Sheet: ASTM A653/A653M, **G90** coating, **either commercial steel, Type B, or structural steel, Grade 33,** unless another grade is required by design loads.

2.3 ABRASIVE NOSINGS

- A. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- B. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
- C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

- A. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated **and capable of withstanding design loads.**
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts,

ASTM A563; and, where indicated, flat washers.

- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, **ASTM A563**; and, where indicated, flat washers.
 - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for **exterior stairs**.
- D. Post-Installed Anchors: **Torque-controlled expansion anchors or chemical anchors** capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
- C. 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.
- D. Zinc-Rich Primer: Comply with SSPC-Paint 20, [**Type I-A**] [**Type I-B**] [**Type I-C**] [**Type II**], Level [**1**] [**2**] [**3**], and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with [**SSPC-Paint 20**] [**ASTM A780/A780M**] and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for [**interior**] [**exterior**] use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

- I. Prefilled Concrete Treads:
 - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of **3000 psi** and maximum aggregate size of **1/2 inch** unless otherwise indicated.
 - 2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
 - 3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, **steel, 6 by 6 inches**, W1.4 by W1.4, unless otherwise indicated on Drawings.
 - a. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] <Insert value>** percent.
 - 4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

- J. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, **railings and guards**, 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.
 - 2. Use connections that maintain structural value of joined pieces.

- B. Assemble stairs, **railings, and guards** in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.

- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated.
 - 2. 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. Form exposed work with accurate angles and surfaces and straight edges.
- F. 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. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **Finish # 3 - Partially dressed weld with spatter removed**.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 - 2. Locate joints where least conspicuous.
 - 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 - 4. Provide weep holes where water may accumulate internally.

2.7 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for **Commercial Service** Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Stringers: Fabricate of **steel channels**.
 - a. Stringer Size: **As required to comply with "Performance Requirements" Article**.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: [**Shop primed**] [**Painted**] [**Galvanized**].
 - 2. Platforms: Construct of **steel channel** headers and miscellaneous framing members as **required to comply with "Performance Requirements" Article**.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: [**Shop primed**] [**Painted**] [**Galvanized**].
 - 3. Weld **or bolt** stringers to headers; weld **or bolt** framing members to stringers and headers. **If using bolts, fabricate and join so bolts are not exposed on finished surfaces**.
 - 4. Where stairs are enclosed by gypsum board **shaft-wall** assemblies, provide hanger rods or struts to support landings from floor construction above or below.

- a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- 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**.
 1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Steel Sheet, Uncoated: **Cold-rolled steel sheet unless otherwise indicated**].
 3. Galvanized Steel Sheet: Galvanized steel shee[, **where indicated**].
 4. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 5. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 6. Shape metal pans to include nosing integral with riser.
 7. Attach abrasive nosings to risers.
 8. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
 9. Provide epoxy-resin-filled treads, reinforced with glass fibers, with non-slip-concrete aggregate finish to tread surface.
 10. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.
- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than **0.097 inch**.
 1. Steel Sheet: Uncoated, hot-rolled steel sheet unless otherwise indicated.
 2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
 3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
 4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.

2.8 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Comply with applicable requirements in **Section 055213 "Pipe and Tube Railings."**
- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to

withstand indicated loads.

1. Rails and Posts: **1-5/8-inch- diameter** top and bottom rails and **1-1/2-inch-square** posts.
2. Picket Infill: **3/4-inch- round** pickets spaced to prohibit the passage of a **4-inch** diameter sphere.
3. Intermediate Rails Infill: **1-5/8-inch- diameter** intermediate rails spaced less than **21 inches** clear.

C. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.
 - a. Provide weep holes where water may accumulate internally.
2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **Finish #3 - Partially dressed weld with spatter removed** as shown in NAAMM AMP 521.

D. Form changes in direction of railings and guards as follows:

1. As detailed.
2. By bending **or by inserting prefabricated elbow fittings**.
3. By flush bends **or by inserting prefabricated flush-elbow fittings**.
4. By radius bends of radius indicated **or by inserting prefabricated elbow fittings of radius indicated**.
5. By inserting prefabricated **elbow fittings**.

E. 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.

F. Close exposed ends of railing and guard members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is **1/4 inch** or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
 - 1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 - 3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
 - 4. 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.

- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
 - 1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

- A. Finish metal stairs after assembly.

- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

- D. 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 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other

embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. 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.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 2. 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.
 3. Comply with requirements for welding in "Fabrication, General" Article.

- F. 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.
 - 2. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.
- H. Install precast terrazzo treads according to manufacturer's written instructions.

3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
 - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 - 2. Plumb posts in each direction, within a tolerance of **1/16 inch in 3 feet**.
 - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed **1/4 inch in 12 feet**.
 - 4. Secure posts, rail ends, and guard ends to building construction as follows:
 - a. Anchor posts to steel by **welding or bolting** to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Install railing gates level, plumb, and secure for full opening without interference.
 - 1. Attach hardware using tamper-resistant or concealed means.
 - 2. Adjust hardware for smooth operation.
- C. Attach handrails to wall with wall brackets.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 2. Secure wall brackets to building construction as **required to comply with performance requirements**.

3.4 REPAIR

- A. Touchup Painting:
 - 1. 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.
 - a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [**Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."**] [**Section 099600 "High-Performance Coatings."**] [**Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."**]
- B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055113

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe and tube railings.
- B. Related Sections include the following:
 - 1. Division 5 Section "Ornamental Railings" for ornamental railings fabricated from pipes and tubes.
 - 2. Division 6 Section "Rough Carpentry" for wood blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- B. Structural Performance: Provide railings that meet the requirements of, and are compliant with, all applicable codes, and capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ 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. 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.
 - 3. Infill of Guards:

- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Uniform load of 25 lbf/sq. ft. applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: For the following:
- 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- 1. 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.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.
- D. Samples for Verification: For each type of exposed finish required.
- 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing and connecting members at intersections.
- E. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- F. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. 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.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 STEEL AND IRON

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

- B. Tubing: ASTM A 500 (cold formed).
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Castings: Either gray or malleable iron, unless otherwise indicated.
 - 1. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
- F. Expanded Metal: ASTM F 1267, Type I (expanded), Class 1 (uncoated).

2.3 FASTENERS

- A. General: Provide the following:
 - 1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- D. Anchors: Provide cast-in-place anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- C. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- 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 work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections, unless otherwise indicated.
- H. 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. 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 flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form simple and compound curves by bending members in 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.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- L. 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 fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- N. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.
- O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

- 1. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.

- B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

- F. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

- 1. Do not apply primer to galvanized surfaces.
- 2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. 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 have been 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 1/16 inch in 3 feet.
 - 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 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch 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 nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets 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 wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.

3.7 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.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 057300 - ORNAMENTAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Aluminum ornamental railings and handrails.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Stairs" for steel tube railings included with metal stairs.
 - 2. Division 5 Section "Pipe and Tube Railings" for railings fabricated from pipe and tube components.
 - 3. Division 6 Section "Rough Carpentry" for wood blocking for anchoring railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- B. Structural Performance: Provide railings that meet the requirements of, and are compliant with, all applicable codes, and capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - 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. 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.
3. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Uniform load of 25 lbf/sq. ft. applied horizontally.
 - c. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. 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.
2. For illuminated railings, include wiring diagrams and roughing-in details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.

3. Welded connections.
4. Brazed connections.
5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.2, "Structural Welding Code--Aluminum."
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 2. Provide allowance for trimming and fitting at site.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. 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.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements, provide product as indicated on Drawings, or comparable products by one of the following:

- 1. Aluminum Ornamental Railings and Handrails:
 - a. Architectural Metal Works.
 - b. ATR Technologies, Inc.
 - c. Blum, Julius & Co., Inc.
 - d. Blumcraft of Pittsburgh.
 - e. Braun, J. G., Company; a division of the Wagner Companies.
 - f. CraneVeyor Corp.
 - g. Livers Bronze Co.
 - h. Newman Brothers, Inc.
 - i. Pisor Industries, Inc.
 - j. Platers Polishing Company; a division of Rippel Architectural Metals.
 - k. Poma Corporation.
 - l. Sterling Dula Architectural Products, Inc.
 - m. Superior Aluminum Products, Inc.
 - n. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - o. Wylie Systems.
 - p. C R Laurence

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails, unless otherwise indicated.
 - 1. Provide brackets with flange tapped for concealed anchorage.

2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.
- C. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- D. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- E. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Components: Type 316 stainless-steel fasteners.
 - 2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 - 3. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless otherwise indicated exposed fasteners are unavoidable.
 - 1. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Anchors: Provide cast-in-place anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Brazing Rods: For copper-alloy railings, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 1. Use primer with a VOC content of 420g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- D. 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.

- E. Form work true to line and level with accurate angles and surfaces.
- F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- H. 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. 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 flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Brazed Connections: Connect copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.
 - 1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
 - 2. Remove flux immediately.
 - 3. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.
- K. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- L. Form simple and compound curves by bending members in 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.
- M. Close exposed ends of hollow railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.
- O. 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 fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Interior Railing Systems: Color Anodic Finish, AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, or thicker.
 1. Color: Black.
- C. Exterior Railing Systems: Color Anodic Finish, AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 1. Color: Black

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. 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 have been 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 1/16 inch in 3 feet.
 - 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 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch 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 nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
 - 2. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets 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 wood stud partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.7 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in field to shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057300

SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

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. Custom-fabricated Glass-supported railings.
2. Custom-fabricated Post-supported railings with glass infill.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.
2. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. 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 items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Each type of glass required.
 - 3. Fittings and brackets.
 - 4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- D. Delegated-Design Submittal: For installed products 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. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

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. Architectural Metal Works.
 - 2. Architectural Railings & Grilles, Inc.
 - 3. ATR Technologies, Inc.
 - 4. Julius Blum & Co., Inc.
 - 5. CraneVeyor Corp.
 - 6. C. R. Laurence Co., Inc.
 - 7. Livers Bronze Co.
 - 8. Newman Brothers, Inc.
 - 9. **P & P Artec. Modesto System, Basis of Design**
 - 10. TACO Metals Inc.
 - 11. Tri Tech, Inc.
 - 12. Wylie Systems.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review. Provide complete system to match the design as indicated in the Drawings.

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. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Stainless Steel: 60 percent of minimum yield strength.
 - 2. Steel: 72 percent of minimum yield strength.
 - 3. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."

- C. 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. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) 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 (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

 - 3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.

- B. Pipe: ASTM A 312/A 312M, Grade TP 304.

- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.
- E. Bars and Shapes: ASTM A 276, Type 304.

2.5 GLASS AND GLAZING MATERIALS

- A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- B. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.
 - 1. Glass Color: Clear.
 - 2. Thickness for Structural Glass Balusters: As required by structural loads, but not less than 12.0 mm.
 - 3. Thickness for Glass Infill Panels: As required by structural loads, but not less than 10.0 mm.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
 - 1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.
- E. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.6 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
 - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193[or ICC-ES AC308].
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

- A. 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.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, but not less than that required to support structural loads].
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
1. Per manufacturer's standard process for system specified.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where 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 to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.9 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Balusters: Provide tempered glass panels.
- C. Infill Panels: Provide tempered glass panels.

2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable

if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.11 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Manufacturer's standard powder coat finish.
 - 1. Color: Custom color to match Architect's sample.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. 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 have been 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 1/16 inch in 3 feet (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 1/4 inch in 12 feet (5 mm in 3 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.

Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

- A. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- B. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
 - 1. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement unless glass was bonded to base and top-rail channels in factory.
 - a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
 - 2. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
 - 3. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections and to prepare test reports.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

- D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants, and nailers.
 - 3. Plywood backing panels.

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. 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.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Expansion anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA C2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat rough carpentry as indicated below:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than (18 inches) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).
 - 1. Use Exterior type for exterior locations and where indicated.
 - 2. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat all rough carpentry unless noted otherwise.

2.4 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. Rooftop equipment bases and support curbs.
 - 4. Cants.

5. Grounds.
 - B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
 1. Mixed southern pine; SPIB.
 2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - C. For exposed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine, No. 1 grade; SPIB.
 2. Spruce-pine-fir (south) or spruce-pine-fir, Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine, No. 2 grade; SPIB.
 2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
 - F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than (1/2-inch) nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. 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. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.

- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: (ASME B18.2.1).
- F. Bolts: Steel bolts complying with (ASTM A 307, Grade A); with (ASTM A 563) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, (1/4 inch) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than (16 inches) o.c.

- C. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as required to maintain specified UL fire rating.:
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 3. Table 2306.1, "Fastening Schedule," in SBCCI's Standard Building Code.
- G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.
- H. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Use finishing nails, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than (1-1/2 inches) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

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 sheathing.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

- 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:

- 1. Preservative-treated plywood.
 - 2. Fire-retardant-treated plywood.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.
- C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

- C. Application: Treat all plywood unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

2.5 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 1/2 inch.
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 1/2 inch.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated on drawings. Comply with the following if information is not provided on drawings:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- F. Install blocking per detail on the drawings.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:

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1. Roof Sheathing:
 - a. Screw to wood trusses.
 - b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
3. Shop priming of interior architectural woodwork.
4. Shop finishing of interior architectural woodwork.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 064214 "Stile and Rail Wood Paneling" for wood paneling that is not specified in this Section.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.

3. Shop finishing materials.
- B. Shop Drawings:
1. Include the following:
 - a. Dimensioned plans, elevations, and sections.
 - b. Attachment details.
 2. Show large-scale details.
 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
 4. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: For each exposed product and for each shop-applied color and finish specified.
1. Size:
 - a. Panel Products: 12 inches by 12 inches.
 - b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- D. Samples for Initial Selection: For each type of shop-applied exposed finish.
1. Size:
 - a. Panel Products: 12 inches by 12 inches.
 - b. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
- E. Samples for Verification: For the following:
1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
 2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For architectural woodwork manufacturer and Installer.
- B. Product Certificates: For the following:
1. Composite wood and agrifiber products.
 2. Adhesives.

1.7 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.8 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
 - 2. Installer Qualifications: Manufacturer of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical interior architectural woodwork as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Architectural Woodwork Standards Grade: Premium.
- B. Hardwood Lumber:
 1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
 2. Wood Moisture Content: 5 to 10 percent.
 3. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
 4. For trim items wider than available lumber, use veneered construction. Do not glue for width.
 5. For base wider than available lumber, glue for width. Do not use veneered construction.
 6. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.
- C. Softwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Wood Moisture Content: 5 to 10 percent.
3. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
4. For trim items wider than available lumber, use veneered construction. Do not glue for width.
5. For base wider than available lumber, glue for width. Do not use veneered construction.
6. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.
7. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.

2.3 HARDWOOD SHEET MATERIALS

- A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
 1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
 1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWWPA U1; Use Category UC3b.
 - a. Provide where in contact with concrete or masonry.
 - b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
 - c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.5 FABRICATION

- A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
 - 1. Ease edges to radius indicated for the following:
 - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
 - b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
 - 1. Disassemble components only as necessary for shipment and installation.
 - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
 - 4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
 - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
 - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.6 SHOP PRIMING

- A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.
- B. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish.
 - 1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.7 SHOP FINISHING

- A. Finish interior architectural woodwork with transparent finish indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.
- C. Transparent Finish:
1. Architectural Woodwork Standards Grade: Premium.
 2. Finish: System - 5, Varnish, Conversion.
 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 4. Staining: Match Architect's sample.
 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
 1. Shim as required with concealed shims.
 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 1. Secure with countersunk, concealed fasteners and blind nailing.
 2. For shop-finished items, use filler matching finish of items being installed.

F. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
1. Inspection entity shall prepare and submit report of inspection.

3.4 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
- B. Where not possible to repair, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
1. Fill nail holes with matching filler where exposed.
 2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.5 CLEANING

- A. Clean interior architectural woodwork on exposed and semi-exposed surfaces.

END OF SECTION 064023

SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

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. Architectural wood cabinets.
- 2. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
- 3. Shop finishing of architectural wood cabinets.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products, cabinet hardware and accessories, and finishing materials and processes.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

- 1. Show details full size.
- 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- 3. Show locations and sizes of cutouts and holes for electrical switches and outlets, and other items installed in architectural wood cabinets.
- 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- 5. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.

D. Samples for Verification:

1. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.
3. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Fabricator.

B. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. Thermoset decorative panels.
3. Glass.
4. Adhesives.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical architectural wood cabinets as shown on Drawings.

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 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.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural wood cabinets with sequence-matched wood veneers.

2.2 ARCHITECTURAL WOOD CABINETS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Type of Construction: Flush overlay.
- C. Wood for Exposed Surfaces:
 - 1. Species: White birch.
 - 2. Cut: Rotary Cut.
 - 3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
 - 4. Matching of Veneer Leaves: Book match.
 - 5. Veneer Matching within Panel Face: Running match.
- D. Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
 - 2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces.
 - 3. Drawer Bottoms: Hardwood plywood.
- E. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

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. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
 - 2. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

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. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal 4 inches long.
- 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 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
- I. Door Locks: BHMA A156.11, E07121. Provide locks at all doors.
- J. Drawer Locks: BHMA A156.11, E07041. Provide locks at all drawers.
- 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. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, 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.

2.7 FABRICATION

- A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Cabinets: 1/16 inch unless otherwise indicated.
- B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. 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.
- D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.8 SHOP FINISHING

- A. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099123 "Interior Painting" for field finishing architectural woodwork not indicated to be shop finished.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.
- C. Transparent Finish:
 - 1. Grade: Premium
 - 2. Staining: Match Architect's sample.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and back-priming.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. 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.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. 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.
 - 1. For shop finished items use filler matching finish of items being installed.

- F. 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. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. 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, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

- G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
 - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

- B. Clean, lubricate, and adjust hardware.

- C. Clean cabinets on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064113

SECTION 064116 – PLASTIC LAMINATE CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Plastic-laminate cabinets.
 - 2. Solid surface material countertops.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for casework.
 - 3. Division 09 Section "Resilient Base and Accessories" for resilient base applied to casework.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material, cabinet hardware and accessories and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
5. Apply WI-certified compliance label to first page of Shop Drawings.

C. Samples for Initial Selection:

1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.
4. Solid-surfacing materials.

D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
2. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish, with edge banding on 1 edge.
3. Exposed cabinet hardware and accessories, one unit for each type and finish.
4. Solid surface material, 6" square.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

G. Qualification Data: For Installer and fabricator.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
- C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Provide high-pressure decorative laminates as indicated in the Drawings
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: Provide products as indicated in the Drawings.
 - 2. Type: As indicated in the Drawings.
 - 3. Colors and Patterns: As indicated in Drawings.
 - 4. Thickness: 2cm deck with 4cm edge.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

- B. Butt Hinges: Stainless-steel, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.
 - 1. Provide Butt Hinges at Reveal Overlay cabinets
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.
 - 1. Provide Frameless Concealed Hinges at Flush Overlay cabinets.
- 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. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - 2. Box Drawer Slides: Grade 1 HD-100; for drawers not more than 6 inches high and 24 inches wide.
 - 3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches high or 24 inches wide.
 - 4. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
 - 5. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
 - 6. Trash Bin Slides: Grade 1HD-100; for trash bins not more than 20 inches high and 16 inches wide.
- H. Door Locks: BHMA A156.11, E07121. Provide locks on all doors.
- I. Drawer Locks: BHMA A156.11, E07041. Provide locks on all drawers.
- J. Grommets for Cable Passage through Countertops: 2-inch Insert size OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, 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 nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 inch thick or Less: 1/16 inch.
 - 2. Edges of Rails and Similar Members More Than 3/4 inch thick: 1/8 inch.
 - 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be

removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.6 PLASTIC-LAMINATE CABINETS

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction:
 - 1. Reveal overlay.
 - a. All locations unless noted otherwise.
 - 2. Flush overlay.
 - a. Front of House spaces (front lobby, public toilets, etc.).
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
 - 4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
- D. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
 - 2. Drawer Sides and Backs: Thermoset decorative panels.
 - 3. Drawer Bottoms: Thermoset decorative panels.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.
- G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Grade: Premium.
- B. Solid-Surfacing-Material Thickness: 2cm.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 2. Fabricate tops with shop-applied backsplashes.
- E. Install integral sink bowls in countertops in shop.
- F. Drill holes in countertops for plumbing fittings, fixtures, and soap dispensers in shop.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.
- F. 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. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064116

SECTION 064214 - STILE AND RAIL WOOD PANELING

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. Stile and rail wood paneling for transparent finish.
2. Wood furring, blocking, shims, and hanging strips for installing stile and rail wood paneling that are not concealed within other construction.
3. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling that are concealed within other construction before paneling installation.
2. Section 064023 "Interior Architectural Woodwork" for wood trim installed on or next to stile and rail wood paneling.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

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

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. Shop Drawings: For stile and rail wood paneling.

1. Include plans, elevations, sections, and attachment details.
 2. Show details full size.
 3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
 4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
 5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 6. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For the following:
1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
 2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished paneling.
 3. Veneer-Faced Panel Products for Transparent Finish: 12 by 12 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
 4. Corner Pieces: 18 inches high by 18 inches wide by 6 inches deep.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product.
- C. Quality Standard Compliance Certificates: AWI Quality Certification Program.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 1. Shop Certification: AWI's Quality Certification Program accredited participant.
- B. Installer Qualifications: Fabricator of products.

- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical stile and rail wood paneling as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling and wood-veneer-faced architectural cabinets, ornamental woodwork, wood trim.

2.2 PANELING, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of stile and rail wood paneling (stile and rail wall surfacing) indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.3 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Wood Species: White Birch, rotary cut.
- C. Panels: Raised panels with veneered faces and solid-lumber rims.
- D. Book and Balance Matched Insert Panels: Book and balance match face veneers within panels. No matching is required between adjacent panels; select and arrange panels for similarity of grain pattern and color between adjacent panels.
- E. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

2.4 MATERIALS

- A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
- B. Wood Moisture Content: 5 to 10 percent.

2.5 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, 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.

- C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.6 FABRICATION

- A. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
 - 1. Lay out one elevation at a time if approved by Architect.
 - 2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
 - 3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
 - 4. Rearrange paneling as directed by Architect until layout is approved.
 - 5. Do not trim end units and other nonmodular-size units to less than modular size until after Architect's approval of layout.
 - 6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.
- C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.7 SHOP FINISHING

- A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Drawings indicate paneling that is required to be shop finished. Finish shop-finished paneling at fabrication shop as specified in this Section.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
- D. Transparent Finish:
1. Grade: Premium.
 2. Finish: System - 5, conversion varnish.
 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 4. Staining: Match Architect's sample.
 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition paneling to humidity conditions in installation areas.
- B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.
- B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
- C. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor paneling to supporting substrate with blind nailing.
 1. Do not use face fastening unless covered by trim.
- E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.
 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.
- B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064214

SECTION 071353 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Rubberized asphalt sheet waterproofing.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide waterproofing that prevents the passage of water.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include Setting Drawings showing layout, sizes, sections, profiles, and joint details of concrete pavers with paver support assemblies.
- C. Samples: For the following products:
 - 1. 12-by-12-inch square of waterproofing.
 - 2. 4-by-4-inch square of drainage panel.
- D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- E. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

- F. Sample Warranty: Copy of waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is authorized, approved, or licensed by waterproofing manufacturer to install manufacturer's products; and who is eligible to receive waterproofing warranty specified.
- B. Source Limitations: Obtain waterproofing materials, protection course, through one source from a single manufacturer.
- C. Mockups: Apply waterproofing to 100 sq. ft of wall to demonstrate surface preparation, crack and joint treatment, corner treatment, and execution quality.
 - 1. Mockup must be inspected and approved by manufacturer representative.
 - 2. Approved mockups may become part of the completed work.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs, Substrate must be inspected and approved by installer prior to beginning installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight within specified warranty period.
 1. Warranty Period: 10 years after date of Substantial Completion.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following products:
 1. Rubberized Asphalt Sheet:
 - a. Bituthene 3000 by Grace.
 2. Other Manufacturers:
 - a. Firestone
 - b. Tremco

2.2 SHEET WATERPROOFING

- A. Rubberized Asphalt Sheet: A self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1mm (0.004 in.) of cross-laminated, high density polyethylene film. Provide rubberized asphalt membrane covered with a release sheet which is removed during installation.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

- B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing or 60-mil- thick, as required by manufacturer.
- C. Bonding Adhesives: Adhesive for bonding polymeric sheets and sheet flashings to substrates and projections.
- D. Splicing Cement and Cleaner: Single-component butyl splicing cement and solvent-based splice cleaner.
 - 1. Butyl Gum Tape: 30-mil-thick-by-6-1/4-inch-wide, uncured butyl with polyethylene release film.
- E. Lap Sealant: Single-component sealant.
- F. In-Seam Sealant: Single-component sealant.
- G. Water Cutoff Mastic: Butyl mastic sealant.
- H. Waterproofing and Sheet Flashing Accessories: Provide sealants, pourable sealers, cone and vent flashings, inside and outside corner flashings, termination reglets, and other accessories recommended by waterproofing manufacturer for intended use.
- I. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch (25 mm) wide, prepunched, with zinc-alloy-body fasteners and stainless-steel pins.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Hydroduct 220 and Hydroduct 660 by Grace.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Notify Architect in writing of anticipated problems using waterproofing over substrate.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrate. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 FULLY ADHERED SHEET INSTALLATION

- A. Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and recommendations in ASTM D 5843.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply bonding adhesive to substrates at required rate and allow to partially dry.
- D. Apply bonding adhesive to sheets and firmly adhere sheets to substrates. Do not apply bonding adhesive to splice area of sheet.
- E. Install fully adhered sheets and auxiliary materials to tie into existing waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.
- G. Horizontal Application: Apply sheets with side laps shingled with slope of deck where possible.
 - 1. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.

3.4 SEAM INSTALLATION

- A. Cement and Tape Splice: Clean splice areas, apply splicing cement and butyl gum tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet terminations.

3.5 SHEET FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.
- B. Form wall flashings using exposed sheet flashing.
- C. Extend deck sheet waterproofing to form wall flashings.
 - 1. Flash penetrations and field-formed inside and outside corners with uncured sheet flashing.
 - 2. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- D. Cover expansion joints and discontinuous deck-to-wall or deck-to-deck joints by extending deck sheet waterproofing over joints.
- E. Terminate and seal top of sheet flashings with mechanically anchored termination bars.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels according to manufacturer's written instructions. Use adhesives or mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.7 FIELD QUALITY CONTROL

- A. Prior to covering completed installation, the completed work must be inspected and approved by manufacturer's representative.

3.8 PROTECTION AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.

- C. Protect installed insulation drainage panels from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071353

SECTION 072100 - THERMAL 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:
 - 1. Spray polyurethane foam insulation.
 - 2. Extruded polystyrene board insulation.
- B. Related Sections:
 - 1. Section 078446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
 - 2. Section 072726 "Synthetic Fluid-Applied Membrane Air Barriers".
 - 3. Section 092530 "Gypsum Sheathing".

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 SPRAY POLYURETHANE FOAM INSULATION

- A. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BaySystems NorthAmerica, LLC.
 - b. BASF corporation.
 - c. Dow Chemical Company (The).
 - d. Gaco Western Inc.
 - e. Icynene Inc.
 - f. SWD Urethane Company.
 - g. Icynene, Inc.
 - 2. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 3. Thickness: Manufacturer's required thickness to provide a minimum R-13.

2.2 EXTRUDED POLYSTYRENE FOAM BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed-cell product extruded with an integral skin.
 - 1. Thickness: 1 1/2 inches, Minimum R-5.
- B. 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

- B. Extend insulation to envelop entire area to be insulated.
- C. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- D. Installing Extruded Polystyrene Foam Board Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards. Fit courses of insulation between masonry ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against gypsum sheathing or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072400 - EIFS

PART 1 GENERAL

1.01 SUMMARY

- A. Provide drainable EIFS with Air and Moisture Barrier for vertical above grade exterior wall substrate surfaces.
- B. RELATED SECTIONS:
 - 1. Section 042000: Unit Masonry Assemblies
 - 2. Section 076200: Sheet Metal Flashing and Trim
 - 3. Section 079200: Sealants and Caulking
 - 4. Section 092530: Gypsum Sheathing

1.02 SUBMITTALS

- A. Manufacturer's specifications, details, installation instructions and product data.
- B. Manufacturer's code compliance report.
- C. Manufacturer's standard warranty.
- D. Applicator's certificate of instruction.
- E. Samples for approval as directed by architect or owner.
- F. EPS board manufacturer's certificate of compliance with ASTM E 2430
- G. Sealant manufacturer's certificate of compliance with ASTM C 1382.
- H. Prepare and submit project-specific details (when required by contract documents).

1.03 REFERENCES

- A. ASTM Standards:
 - 1. C 578 Specification for Preformed, Cellular Polystyrene Thermal Insulation
 - 2. C 1382 Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish Systems (EIFS) Joints
 - 3. D 1382 Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish System (EIFS) Joints
 - 4. D 1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - 5. D 2247 Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 - 6. D 2370 Test Method for Tensile Properties of Organic Coatings

7. E 84 Test Method for Surface Burning Characteristics of Building Materials
8. E 96 Test Methods for Water Vapor Transmission of Materials
9. E 119 Method for Fire Tests of Building Construction and Materials
10. E 2098 Test Method for Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish System after Exposure to a Sodium Hydroxide Solution
11. E 2134 Test Method for Evaluating the Tensile-Adhesion Performance of an Exterior Insulation and Finish System (EIFS)
12. E 2273 Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish System (EIFS) Clad Wall Assemblies
13. E 2430 Specification for Expanded Polystyrene (EPS) Thermal Insulation Boards for use in Exterior Insulation and Finish Systems (EIFS)
14. E 2485 Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings
15. E 2486 Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
16. E 2570 Test Method for Water-Resistive (WRB) Coatings used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage

B. Building Code Standards

1. AC235 Acceptance Criteria for EIFS Clad Drainage Wall Assemblies (April, 2008)

C. National Fire Protection Association (NFPA) Standards

1. NFPA 268, "Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source"
2. NFPA 285, "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus"

D. Other Referenced Documents

1. American Association of Textile Chemists and Colorists AATCC-127 Water Resistance: Hydrostatic Pressure Test
2. GA-600 Fire Resistance Design Manual
3. APA Engineered Wood Association E 30, Engineered Wood Construction Guide
4. ICC-ES ESR-1748, Evaluation Report for StoTherm® NExT™ EIFS.
5. ICC-ES ESR-1233, Evaluation Report for StoGuard™

1.04 DESIGN REQUIREMENTS

A. Wind Load

1. Design for maximum allowable system deflection, normal to the plane of the wall, of L/240.

2. Design for wind load in conformance with code requirements and as indicated on drawings.
- B. Moisture Control
1. Prevent the accumulation of water behind the EIF system, either by condensation or leakage through the wall construction, in the design and detailing of the wall assembly.
 - a. Provide flashing to direct water to the exterior where it is likely to penetrate components in the wall assembly, including, above window and door heads, beneath window and door sills, at roof/wall intersections, decks, abutments of lower walls with higher walls, above projecting features, and at the base of the wall.
 - b. Air Leakage Prevention-- provide continuity of air barrier system at foundation, roof, windows, doors and other penetrations through the system with connecting and compatible air barrier components to minimize condensation and leakage caused by air movement.
- C. Color Selection:
1. Select finish coat with a light reflectance value of 20 or greater.
- D. Joints
1. Provide minimum 3/4 inch wide expansion joints in the EIFS where they exist in the substrate or supporting construction, where the EIFS adjoins dissimilar construction or materials, at changes in building height, and at floor lines in multi-level wood frame construction.
 2. Provide minimum 1/2 inch wide perimeter sealant joints at all penetrations through the EIFS (windows, doors, etc.).
 3. Provide joints so that Air Barrier continuity is maintained across the joint and drain joints to the exterior.
- E. Grade Condition
1. Do not install EIFS below grade (unless designed for use below grade and permitted by code) or for use on surfaces subject to continuous or intermittent water immersion or hydrostatic pressure. Provide minimum 6 inch clearance above finished grade as required by code.
- F. Trim, Projecting Architectural Features and Reveals
1. All trim and projecting architectural features must have a minimum 1:2 [27°] slope along their top surface. All horizontal reveals must have a minimum 1:2 [27°] slope along their bottom surface. Increase slope for northern climates to prevent accumulation of ice/snow and water on surface. Where trim/feature or bottom surface of reveal projects more than 2 inches from the face of the EIFS

wall plane, protect the top surface with waterproof base coat. Periodic inspections and increased maintenance may be required to maintain surface integrity of EIFS on weather exposed sloped surfaces. Limit projecting features to easily accessible areas and limit total area to facilitate maintenance and minimize maintenance. Refer to Sto details 1.04a and 1.04b.

2. Do not use EIFS on weather exposed projecting ledges, sills, or other projecting features unless supported by framing or other structural support and protected with metal coping or flashing. Refer to Sto detail 10.61.

G. Insulation Thickness

1. Minimum EPS insulation thickness is 1 inch.
2. Maximum EPS insulation thickness is 12 inches when installed in accordance with ESR- 1748 (including architectural features).

H. Fire Protection

1. Do not use foam plastic in excess of 12 inches thick on noncombustible type construction unless approved by the code official.
2. Where a fire-resistance rating is required by code use EIFS over rated assembly (EIFS is considered to not add or detract from the fire-resistance of the rated assembly).
3. Refer to manufacturer's applicable code compliance report for other limitations that may apply.

1.05 PERFORMANCE REQUIREMENTS

Table 1—Air/Moisture Barrier Performance

TEST	METHOD	CRITERIA	RESULT
1. Water Penetration Resistance	AATCC 127 (Water Column)	Resist 21.6 in (55 cm) water for 5 hours before and after aging	Pass
2. Water Penetration Resistance after Cyclic Wind Loading	ASTM E 1233 / ASTM E 331	No water at exterior plane of sheathing after 10 cycles @ 80% design load and 75 minutes water spray at 6.24 psf (299 Pa) differential	No water penetration on Plywood, OSB, and Glass Mat Faced Gypsum sheathings
3. Water Resistance Testing	ASTM D 2247	Absence of deleterious effects after 14 day exposure	No deleterious effects
4. Water Vapor Transmission	ASTM E 96 Method B (Water Method)	Measure	Sto Gold Fill®*: 17.3 perms [994 ng/(Pa·s·m²)]
5. Air Leakage	ASTM E 283	<0.06 cfm/ft² (0.00030m³/s·m²)	<0.0044 cfm/ft² (0.000022 m³/s·m²)
6. Structural Integrity	ASTM E 330	2-inches (51 mm) H₂O pressure (positive & negative) for 1 hour.	Pass
7. Dry Tensile Strength	ASTM D 882	20 lbs/in (3503 N/m), minimum before and after aging	Sto Gold Fill®*: 159 lbs/in (27845 N/m)) before aging 213 lbs/in (37302 N/m) after aging
8. Pliability	ASTM D 522	No Cracking or Delamination using 1/8" (3 mm) mandrel at 14°F (-10°C) before and after aging	Pass
9. Surface Burning	ASTM E 84	Flame Spread 0 – 25 for NFPA Class A, UBC Class I	Flame Spread: 5 Smoke Density: 10
10. Tensile Adhesion	ASTM C 297	>15 psi (103 kPa)	>30 psi (207 kPa) to Plywood, OSB, Glass Mat Faced Gypsum sheathings

* Note: Sto Gold Fill testing with Sto Detail Mesh reinforcement

Table 2—EIFS Weather Resistance and Durability Performance

TEST	METHOD	CRITERIA	RESULTS
1. Accelerated Weathering	ASTM G 153 (Formerly ASTM G 23)	No deleterious effects* at 2000 hours when viewed under 5x magnification	Pass
2. Accelerated Weathering	ASTM G 154 (Formerly ASTM G 53)	No deleterious effects* at 2000 hours when viewed under 5x magnification	Pass @ 5000 hours
3. Freeze/Thaw Resistance	ASTM E 2485	No deleterious effects* at 10 cycles when viewed under 5x magnification	Pass @ 90 cycles
4. Water Penetration	ASTM E 331 (modified per ICC-ES AC 235)	No water penetration beyond the plane of the base coat/EPS board interface after 15 minutes at 6.24 psf (299 Pa) or 20% of design wind pressure, whichever is greater	Pass at 12.0 psf (575 Pa) after 30 minutes
5. Drainage Efficiency	ASTM E 2273	90% minimum	> 99%
6. Tensile Adhesion	ASTM E 2134	Minimum 15 psi (103kPa) tensile strength	Pass
7. Water Resistance	ASTM D 2247	No deleterious effects* at 14 day exposure	Pass @ 60 days
8. Salt Spray	ASTM B 117	No deleterious effects* at 300 hours	Pass @ 3000 hrs
9. Abrasion Resistance	ASTM D 968	No cracking or loss of film integrity at 528 quarts (500 L) of sand	Pass
10. Mildew Resistance	ASTM D 3273	No growth supported during 28 day exposure period	No growth at 42 days
11. Impact Resistance	ASTM E 2486	Level 1: 25-49 in-lbs (2.83-5.54J) Level 2: 50-89 in-lbs (5.65-10.1J) Level 3: 90-150 in-lbs (10.2-17J) Level 4: >150 in-lbs (>17J)	Pass with one layer Sto Mesh Pass with two layers Sto Mesh Pass with one layer Sto Intermediate Mesh Pass with one layer Sto Armor Mat and one layer Sto Mesh

*No deleterious effects: no cracking, checking, crazing, erosion, rusting, blistering, peeling or delamination

Table 3—EIFS and Air/Moisture Barrier Fire Performance

TEST	METHOD	CRITERIA	RESULT
1. Fire Endurance	ASTM E 119	Maintain fire resistance of existing rated assembly	Pass*
2. Intermediate Scale Multi-Story Fire Test	NFPA 285 (UBC Standard 26-9)	1. Resistance to vertical spread of flame within the core of the panel from one story to the next 2. Resistance to flame propagation over the exterior surface 3. Resistance to vertical spread of flame over the interior surface from one story to the next 4. Resistance to significant lateral spread of flame from the compartment of fire origin to adjacent spaces	Pass with 12 inches of EPS insulation *
3. Radiant Heat Ignition	NFPA 268	No ignition @ 20 minutes	Pass with 12 inches of EPS insulation
4. Surface Burning (individual components)	ASTM E 84	Individual components shall each have a flame spread of 25 or less, and smoke developed of 450 or less	Flame: 0 Smoke Developed: 5

Note: * indicates results based on extrapolation of data from series testing. ASTM E119 testing performed on assembly with 4 inch (305 mm) thick EPS.

Table 4—EIFS Component Performance

TEST	METHOD	CRITERIA	RESULT
1. Alkali Resistance of Reinforcing Mesh	ASTM E 2098	Greater than 120 pli (21 dN/cm) retained tensile strength	Pass
2. Requirements for Rigid PVC Accessories	ASTM D 1784	Meets cell classification 13244C	Pass

1.06 QUALITY ASSURANCE

A. Manufacturer requirements

- a. Member in good standing of the EIFS Industry Members Association (EIMA).
- b. System manufacturer for a minimum of twenty-five (25) years.
- c. Manufacturing facilities ISO 9001:2000 Certified Quality System.

B. Contractor requirements

1. Engaged in application of EIFS for a minimum of three (3) years.
2. Knowledgeable in the proper use and handling of Sto materials, possessing certificate of completion for on-line Sto EIFS application test.
3. Employ skilled mechanics who are experienced and knowledgeable in EIFS application, and familiar with the requirements of the specified work.
4. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.
5. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications.

C. Insulation board manufacturer requirements

1. Recognized by Sto as capable of producing insulation board to meet system requirements, and hold a valid licensing agreement with Sto.
2. Listed by an approved agency.
3. Label insulation board with information required by Sto, the approved listing agency and the applicable building code.

D. Inspections

1. Provide independent third-party inspection where required by code or contract documents.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.
- B. Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32°C). Store away from direct sunlight.
- C. Protect Portland cement-based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.

1.08 PROJECT/SITE CONDITIONS

- A. Maintain ambient and surface temperatures above 40°F (4°C) during application and drying period, minimum 24 hours after application of Air/Moisture barrier and EIFS.
- B. Provide supplementary heat for installation in temperatures less than 40°F (4°C).
- C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

1.09 COORDINATION/SCHEDULING

- A. Provide site grading such that EIFS terminates above finished grade a minimum of 6 inches (150 mm) or as required by code.
- B. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors and other wall penetrations to provide a continuous air and moisture barrier.
- C. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall.
- D. Coordinate installation of windows and doors so air barrier components are connected to them to provide a continuous air barrier.
- E. Install window and door head flashing immediately after windows and doors are installed.
- F. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
- G. Install copings and sealant immediately after installation of the EIF system and when EIFS coatings are dry.
- H. Attach penetrations through EIFS to structural support and provide water tight seal at penetrations.

1.10 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide Air/Moisture Barrier, drainable EIF System and accessories from single source manufacturer or approved supplier.
- B. The following are acceptable manufacturers:
 - 1. Sto Corp.--Air/Moisture Barrier, EIF System
 - 2. DRYVIT
 - 3. PAREX
- C. Basis of Design: STO Sto-Therm Essence Next

2.02 AIR/MOISTURE BARRIER

A. StoGuard™

- a. Waterproof Coating: Sto Gold Coat®—ready mixed waterproof coating for wall substrates and sheathings.

2.03 ADHESIVE

A. Cementitious Adhesives

1. Sto Primer/Adhesive--acrylic based adhesive mixed with portland cement (for use over exterior glass mat faced gypsum sheathing (compliant with ASTM C 1177), exterior cementitious sheathing, concrete, masonry or cement plaster surfaces.

2.04 INSULATION BOARD

- A. Nominal 1.0 lb/ft³ (16 kg/m³) Expanded Polystyrene (EPS) insulation board in compliance with ASTM E 2430 and ASTM C 578 Type I requirements.

2.05 BASE COAT

A. Cementitious Base Coats

1. Sto Primer/Adhesive--acrylic based base coat mixed with portland cement.

2.06 REINFORCING MESHES

A. High Impact Mesh

1. Sto Intermediate Mesh--nominal 11.2 oz./yd² (380 g/m²), high impact, interwoven, open weave glass fiber fabric with alkaline resistant coating for compatibility with Sto materials (*achieves High Impact Classification*).

2.07 PRIMER

- A. Sto Primer Sand—acrylic based tinted primer with sand for roller application.

2.08 FINISH COAT

- A. Sto Essence DPR Finish —acrylic based textured wall coating with graded marble aggregate.

1. Color: Match Architect's sample.

2. Texture:
 - a. Fine. See Drawings for locations.
 - b. StoCreativ Lux. See Drawings for locations.

2.09 JOB MIXED INGREDIENTS

- A. Water--Clean and potable.
- B. Portland cement--Type I, Type II, or Type I-II in conformance with ASTM C 150.

2.10 ACCESSORIES

- A. Starter Track— Rigid PVC (polyvinyl chloride) plastic track Part No. STDE as furnished by Plastic Components, Inc., 9051 NW 97th Terrace, Miami, Florida 33178 (800 327-7077) or equivalent.

2.11 MIXING

- A. Sto Gold Fill®--mix with a clean, rust-free high speed mixer to a uniform consistency.
- B. Sto Gold Coat®--mix with a clean, rust-free high speed mixer to a uniform consistency.
- C. Sto Primer/Adhesive: mix ratio with portland cement is 1:1 by volume. Pour Sto Primer/Adhesive into a clean mixing pail. Add portland cement, mix to a uniform consistency and allow to set for approximately five minutes. Adjust mix if necessary by adding up to 8 fl. oz. (0.24L) of water per pail and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent.
- D. Sto primer--mix with a clean, rust-free high speed mixer to a uniform consistency.
- E. Sto Essence DPR Finish --mix with a clean, rust-free high speed mixer to a uniform consistency. A small amount of water may be added to adjust workability. Limit addition of water to amount needed to achieve the finish texture
- F. Mix only as much material as can readily be used.
- G. Do not use anti-freeze compounds or other additives.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. Prequalify under Quality Assurance requirements of this specification (section 1.06 B).

3.02 EXAMINATION

- A. Inspect surfaces for:
 - 1. Contamination—algae, chalkiness, dirt, dust, efflorescence, form oil, fungus, grease, laitance, mildew or other foreign substances.
 - 2. Surface absorption and chalkiness.
 - 3. Cracks—measure crack width and record location of cracks.
 - 4. Damage and deterioration.
 - 5. Moisture content and moisture damage—use a moisture meter to determine if the surface is dry enough to receive the EIFS and record any areas of moisture damage.
 - 6. Compliance with specification tolerances—record areas that are out of tolerance (greater than ¼ inch in 8-0 feet [6mm in 2438 mm] deviation in plane).
- B. Inspect sheathing application for compliance with applicable requirement.
- C. Report deviations from the requirements of project specifications or other conditions that might adversely affect the Air/Moisture Barrier and EIFS installation to the General Contractor. Do not start work until deviations are corrected.

3.03 SURFACE PREPARATION

- A. Remove surface contaminants on concrete and concrete masonry surfaces.
- B. Apply conditioner by sprayer or roller to chalking or excessively absorptive surfaces.
- C. Replace weather-damaged sheathing and repair damaged or cracked surfaces.
- D. Level surfaces to comply with required tolerances.
- E. Repair cracks, spalls or damage in concrete or concrete masonry surfaces.

3.04 INSTALLATION

- A. Starter Track
 - 1. Strike a level line at the base of the wall to mark where the top of the starter track terminates.
 - 2. Attach the starter track even with the line into the structure a maximum of 16 inches on center with the proper fastener: Type S-12 corrosion resistant screws for steel framing with minimum 3/8 inch penetration, and galvanized or zinc coated nails for wood framing with minimum 3/4 inch penetration. Attach between studs into blocking as needed to secure the track flat against the wall surface. For solid wood sheathing or concrete/masonry surfaces, attach directly at 12 inches on center maximum.
 - 3. Butt sections of starter track together. Miter cut outside corners and abut. Snip front flange of one inside corner piece (to allow EPS Board to be seated inside of track) and abut.
 - 4. Install Starter Track at other EIF System terminations as designated on detail drawings: above roof along dormers or gable end walls, and beneath window sills with concealed flashing.

B. Splice Strips for Starter Track and Flashing

1. Starter Track, Window/Door Head Flashing and Side Wall Step Flashing: install 2 inch (51 mm) wide diagonal splice strips of detail mesh at ends of head flashings. Install minimum 4 inch (100 mm) wide splice strips of detail mesh between back flange of starter track, head flashings and roof/side wall step flashing. Center the mesh so it spans evenly between the back flange of the Starter Track or flashing and the sheathing. Embed the mesh in the wet joint compound and trowel smooth.
2. Apply waterproof coating over the splice strip when the joint compound is dry (refer to Sto Details 10.00 and 10.23b).

C. Backwrapping

1. Apply a strip of detail mesh to the dry air/moisture barrier at all system terminations (windows, doors, expansion joints, etc.) except where the Starter Track is installed. The mesh must be wide enough to adhere approximately 4 inches of mesh onto the wall, be able to wrap around the insulation board edge and cover a minimum of 2 ½ inches on the outside surface of the insulation board. Adhere mesh strips to the air/moisture barrier and allow them to dangle until the backwrap procedure is completed. Alternatively, pre-wrap terminating edges of insulation board.

D. Adhesive Application and Installation of Insulation Board

1. Rasp the interior lower face of insulation boards to provide a snug friction fit into the Starter Track. (*Note: rasping prevents an outward bow at the Starter Track*).
2. Apply adhesive to the back of the insulation board with the proper size stainless steel notched trowel. Apply uniform ribbons of adhesive parallel with the SHORT dimension of the board so that when boards are placed on the wall the ribbons will be VERTICAL. Apply adhesive uniformly so ribbons of adhesive do not converge.
3. Immediately place insulation boards in a running bond pattern on the wall with the long dimension horizontal. Start by inserting the lower edge of the boards inside the starter track at the base of the wall until they contact the bottom of the track. Apply firm pressure over the entire surface of the boards to ensure uniform contact of adhesive. Bridge sheathing joints by a minimum of 6 inches. Interlock inside and outside corners.
4. Butt all board joints tightly together to eliminate any thermal breaks in the EIFS. Care must be taken to prevent any adhesive from getting between the joints of the boards.
5. Cut insulation board in an L-shaped pattern to fit around openings. Do not align board joints with corners of openings.
6. Remove individual boards periodically while the adhesive is still wet to check for satisfactory contact with the substrate and the back of the insulation board, and for spacing between ribbons of adhesive. An equal amount of adhesive must be on the substrate and the board when they are removed, as an indication of

adequate adhesion. Do not use nails, screws, or any other type of non-thermal mechanical fastener.

E. Slivering and Rasping of Insulation Board Surface

1. After insulation boards are firmly adhered to the substrate, fill any open joints in the insulation board layer with slivers of insulation or spray foam. Use spray foam that is identified by the spray foam manufacturer as suitable for this use.
2. Rasp the insulation board surface to achieve a smooth, even surface and to remove any ultraviolet ray damage.

F. Trim, Reveals and Projecting Aesthetic Features

1. Attach features and trim where designated on drawings with adhesive to the insulation board or sheathing surface. Slope the top surface of all trim/features minimum 1:2 (27°) and the bottom of all horizontal reveals minimum 1:2 (27°).
2. Cut reveals/aesthetic grooves with a hot-knife, router or groove-tool in locations indicated on drawings.
3. Offset reveals/aesthetic grooves minimum 3 inches from insulation board joints.
4. Do not locate reveals/aesthetic grooves at high stress areas such as corners of windows, doors, etc.
5. A minimum $\frac{3}{4}$ inch thickness of insulation board must remain at the bottom of the reveals/aesthetic grooves.

G. Completion of Backwrapping

1. Complete the backwrapping procedure by applying base coat to exposed edges of insulation board and approximately 4 inches onto the face of the insulation board. Pull mesh tight around the board and embed it in the base coat with a stainless steel trowel. Use a corner trowel for clean, straight lines. Smooth any wrinkles or gaps in the mesh.

H. Base Coat and Reinforcing Mesh Application

1. Apply minimum 9x12 inch diagonal strips of detail mesh at corners of windows, doors, and all penetrations through the system. Embed the strips in wet base coat and trowel from the center to the edges of the mesh to avoid wrinkles.
2. Apply detail mesh at trim, reveals and projecting architectural features. Embed the mesh in the wet base coat. Trowel from the base of reveals to the edges of the mesh.
3. Ultra-High impact mesh application to a minimum height of 6'-0" above finished grade at all areas accessible to pedestrian traffic and other areas exposed to abnormal stress or impact apply base coat over the insulation board with StoSilo spray equipment or a stainless steel trowel to a uniform thickness of approximately 1/8 inch. Work horizontally or vertically in strips of 40 inches, and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Butt the mesh at seams. Allow the base coat to dry.

4. Standard mesh application: Apply base coat over the insulation board, including areas with Ultra-High impact mesh, with StoSilo spray equipment or a stainless steel trowel to a uniform thickness of approximately 1/8 inch (3 mm). Work horizontally or vertically in strips of 40 inches, and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Overlap mesh not less than 2-1/2 inches at mesh seams and at overlaps of detail mesh. Feather seams and edges. Double wrap all inside and outside corners with minimum 2-1/2 inch overlap in each direction. (Alternate corner treatment: embed corner mat in base coat, allow to dry, and then overlap up to corner with standard reinforcing mesh embedded in base coat). Avoid wrinkles in the mesh. The mesh must be fully embedded so that no mesh color shows through the base coat when it is dry. Re-skim with additional base coat if mesh color is visible.
5. Sloped Surfaces: for trim, reveals, aesthetic bands, cornice profiles, sills or other architectural features that project beyond the vertical wall plane more than 2 inches apply waterproof base coat with a stainless steel trowel to the weather exposed sloped surface and minimum four inches above and below it. Embed standard mesh or detail mesh in the waterproof base coat and overlap mesh seams a minimum of 2-1/2 inches.
6. Allow base coat to thoroughly dry before applying primer or finish.

I. Primer application

1. Apply primer evenly with brush, roller or proper spray equipment over the clean, dry base coat and allow to dry thoroughly before applying finish.

J. Finish Coat Application

1. Apply finish directly over the base coat or primed base coat when dry. Apply finish by spraying or troweling with a stainless steel trowel, depending on the finish specified. Follow these general rules for application of finish:
 - a. Avoid application in direct sunlight.
 - b. Apply finish in a continuous application, and work to an architectural break in the wall.
 - c. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
 - d. Do not install separate batches of finish side-by-side.
 - e. Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.
 - f. Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.

3.05 PROTECTION

- A. Provide protection of installed materials from water infiltration into or behind them.
- B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION 072400

**SECTION 072726 – SYNTHETIC FLUID-APPLIED MEMBRANE AIR BARRIERS,
VAPOR PERMEABLE**

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 fluid-applied, vapor-permeable membrane air barriers.
- B. Related Requirements:
 - 1. Division 04 Section "Unit Masonry" for flashings embedded in masonry wall construction to which membrane air barriers will transition.
 - 2. Division 09 Section "Gypsum Sheathing" for wall sheathings

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Submit test data by qualified testing agency indicating membrane air barrier meets performance requirements, when requested by Architect.
- B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, flashing transition assemblies and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come into contact with membrane air barriers.
- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- C. Fire Testing: From a qualified testing agency, documentation that the air barrier system as a component of a wall assembly has been tested and passed NFPA285.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, with a record of successful installations on projects of similar scope.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 1. Build integrated mockups of exterior wall assembly as specified in other Sections, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, opening transition assembly, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection by testing agency of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Material Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 COORDINATION

- A. Coordinate installation of membrane air barrier with completion of roofing and other moisture protection work.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to embedded flashing, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 2357.
- C. Fire Testing: Air barrier system as a component of a wall assembly shall have been tested and passed NFPA285.

2.3 SYNTHETIC VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Synthetic Polymer Membrane:

1) **Basis of Design: Tremco Incorporated, an RPM company; ExoAir 230.**

- 2) DuPont
- 3) Carlisle
- 4) WR Meadows
- 5) Tyvek

2. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
- b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M, Method B
- c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
- d. Combustion Characteristics: Flame spread, not greater than 25; smoke development, not greater than 450, ASTM E 84.
- e. UV Resistance: minimum 150 daily cycles of UV and water spray with no visible deterioration in QUV-B Weathering Chamber.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.
- C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, cross-laminated polyethylene film with release liner backing.
- D. Modified Bituminous Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.
- E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- G. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- H. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- A. Transition Strip: Cured low-modulus silicone extrusion, with reinforcing ribs, sized to fit opening widths, with aluminum race for insertion into aluminum framing extrusions, with the following characteristics:

1. Basis of Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly.
 2. Tensile Strength: 1100 psi (7.6 MPa), per ASTM D 412.
 3. Ultimate Elongation: 500 percent, per ASTM D 412.
 4. Tear Strength: 110 lb/in (19.3 kN/m).
 5. Hardness, Type A Durometer: 40, per ASTM D 2240.
- B. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O, and approved by membrane air manufacturer for adhesion and compatibility with membrane air barrier and accessories. Comply with Division 07 Section "Joint Sealants."
1. Basis of Design: Tremco, Inc., Spectrem 1.
- C. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 3. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Gypsum Sheathing:
 - 1. Fill joints greater than 1/4 inch and less than 1/2" with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.
 - 2. For joints 1/2" or greater, apply transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions

3.4 PRIMER

- A. Apply primer to substrates at required rate and allow it to dry.
- B. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- C. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

3.5 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

- E. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply opening transition assembly so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, modified bituminous strip at nonmetallic flashings or counterflashing strip at metal flashings.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.6 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness per manufacturer's written installation instructions, applied in one or more equal coats.
- C. Apply transition strip a minimum of 6 inches onto cured air-barrier material or overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.7 FIELD QUALITY CONTROL

- A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 2. Continuous structural support of air-barrier system has been provided.
 3. Site conditions for application temperature and dryness of substrates have been maintained.
 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 5. Surfaces have been primed, if applicable.
 6. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 7. Termination mastic has been applied on cut edges.
 8. Strips and transition strips have been firmly adhered to substrate.
 9. Compatible materials have been used.
 10. Transitions at changes in direction and structural support at gaps have been provided.
 11. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 12. All penetrations have been sealed.
- B. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions. Air baffle installer must accept substrate in writing prior to installation.

3.8 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 073200 - COMPOSITE ROOF TILE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Composite Roof Tiles - Double Roman.
- B. Tile Roof Accessories for Composite System.

1.2 RELATED SECTIONS

- A. Section 061000 - Rough Carpentry.
- B. Section 076200 - Flashing and Sheet Metal.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D3161/D3161M-20 - Standard Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method)
 - 2. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings
- B. Factory Mutual (FM):
 - 1. FM 4473 - Specification Test Standard for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300 - Submittal Requirements.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
- C. Verification Samples: Two representative units of each type, size, pattern, and color.
- D. Shop Drawings: Indicate metal flashing profiles, joint locations, fastening locations, and installation details. Indicate tile layout with location of cut and special shaped tiles identified.
- E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- F. Warranty documents, issued and executed by manufacturer of roof tile, countersigned by roof tile installer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience with projects of similar scope and complexity and/or supervision by a manufacturer's authorized installation representative.

- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
 - 1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
 - 2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
 - 3. Retain mock-up during construction as a standard for comparison with completed work.
 - 4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Agenda shall include schedule, responsibilities, critical path items and approvals.
 - 1. Require attendance by representatives of the following:
 - a. Installer of this section.
 - b. Architect.
 - c. Other entities directly affecting, or affected by, construction activities of this section.
 - d. Manufacturer's representative.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's unopened pallets, labeled with data indicating compliance with specified requirements.
- B. Storage and Protection:
 - 1. Store products in manufacturer's unopened packaging until ready for installation.
 - 2. Maintain dry storage area for products of this section until installation of products.

1.8 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.10 WARRANTY

- A. Manufacturer's Warranty: Roof tile manufacturer's 50-year limited warranty against defects in product workmanship and materials.
- B. Tile will be free from manufacturing defects, not rot, split, splinter or suffer structural damage from normal weather conditions and termite or fungal decay when subject to normal use for a period of fifty (50) years from date of original purchase or will not blow off or otherwise

become damaged by winds less than eighty (80) miles per hour for a period of ten (10) years from the date of original purchase.

- C. Warranty does not provide protection against any failure, defect or damage caused by situations and events beyond Quarrix's control, including but not limited to:
1. Natural Disasters: Hail over 1.0 inch (25 mm) in diameter, fire, smoke, chemicals, earthquakes, lightning, or static electricity.
 2. Falling, thrown, or blown objects.
 3. Neglect, abuse, misuse (including faulty installation, repair, or maintenance), improper transportation, handling or storage of Quarrix Products or other failure to comply with instructions in the documentation and/or manual accompanying Quarrix Products.
 4. Modification of Quarrix Products not provided by Quarrix.
 5. Malfunction of any product not provided by Quarrix with which Quarrix Products are used or combined.
 6. Use, modification, or other treatment of Quarrix Products in a manner for which it was not designed or intended.
 7. Defects or damage due to inferior building practices, ventilation, drainage issues or roof slopes inconsistent with snow and ice control.
 8. Replacement under or subjection to abnormal use conditions.
 9. Normal wear and tear including the natural effects of progressive aging on the color and surface of the tile
 10. Discoloration and variations in color or uniformity caused by weathering and/or UV exposure, staining due to shade or sap, ash or proximity to metals that might cause discoloration.
 11. Foot traffic.
 12. Vandalism or other malicious actions.
 13. Quarrix Products blown off by winds more than 80 mph.
- D. Refer to the Quarrix Composite Tile Limited Warranty and Certificate of Warranty for complete details.

1.11 EXTRA MATERIALS

- A. Provide an additional one percent of installed roof tiles, but not less than one full square, for Owner's use in roof maintenance.
- B. Furnish extra materials packaged with protective covering for storage and identified with labels clearly describing contents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Quarrix Building Products, A Division of Verscene an LDI Company, which is located at: 705 Pennsylvania Ave. S.; Minneapolis, MN 55426; Toll Free Tel: 800-438-2920; Tel: 763-540-9700; Fax: 763-540-9709; Email: [request info \(marketing@quarrix.com\)](mailto:request_info@quarrix.com); Web: <http://www.quarrix.com>
- B. Additional Manufacturers:
 1. Brava
 2. Boral
 3. Crown
 4. Ludowici
 5. Vera

2.2 COMPOSITE ROOF TILE

- A. Basis or Design: Quarrix Composite Roof Tile;
1. Profile: Similar to high barrel Spanish tile.
 2. Material: Engineered polymer; high-density polyethylene (HDPE) base.
 3. Appearance: Textured in appearance to replicate look of true clay and concrete tile.
 4. Size:
 - a. Field Tile (LxWxH): 16-1/2 x 13 x 2-1/4 inches.
 - b. Hip, Ridge, and Rake Tile (LxWxH): 16-1/2 x 8-1/2 x 3-7/8 inches.
 - c. Hip Starter Tile (LxWxH): 17-1/4 x 8-1/8 x 3-7/8 inches.
 5. Performance:
 - a. ASTM E108 Class A Fire Resistance: When installed over two layers of GAF VersaShield Underlayment.
 - b. ASTM E108 Class C Fire Resistance: When installed over one of the following:
 - 1) Self-adhered membrane: A minimum 30 lbs felt meeting requirements of ASTM D226 Type II.
 - 2) Listed synthetic underlayment per ASTM 108/UL790; Class C.
 - c. Wind Resistance per ASTM D3161/D 3161M-20: 110 mph.
 - d. Hail: Class 4 impact rating, tested in accordance with FM 4473.
 6. Exposure per Tile (LxW): 13-1/2 x 11-19/32 inches (343 x 294 mm).
 7. Fire Rating: Class A.
 - a. Weight per Composite Tile:
 - 1) Field Tile: 3.3 lbs (1.50 kg).
 - 2) Hip, Ridge, and Rake Tile: 2.2 lbs (1.00 kg).
 - 3) Hip Starter Tile: 2.09 lbs (0.95 kg).
 - b. Weight per Square: 297 lbs (134.72 kg).
 8. Fire Rating: Class C.
 - a. Weight per Composite Tile:
 - 1) Field Tile: 3.0 lbs (1.36 kg).
 - 2) Hip, Ridge, and Rake Tile: 2 lbs (0.91 kg).
 - 3) Hip Starter Tile: 1.9 lbs (0.86 kg).
 - b. Weight per Square: 270 lbs (122.47 kg).
 9. Color: Canyon Earth.

2.3 TILE ROOF ACCESSORIES

- A. Underlayment: Self-Adhering, High-Temperature Sheet: 45 to 60 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- 1) Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 2) Low Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3) Products:
 - a) Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR."
 - b) Grace, W. R. & Co.; Vycor Ultra.
 - c) Henry Company; Perma-Seal PE.
 - d) Metal-Fab Manufacturing, LLC; MetShield.
 - e) TC MiraDRI; WIP 300HT.
- B. DryRoof Roof Battens: Quarrix DryRoof Roof Battens. Corrosion-free, laminated high-

density polyethylene (HDPE) corrugated plastic. Layers of corrugated plastic must be glued, not stapled.

1. Color: Black.
 2. Dimensions (WxLxH): 1-1/2 x 96 x 3/4 inches.
- C. Upper and Lower Metal/Eave Closures: Quarrix coated steel Eave Closures (birdstop) pressure fit between the weather checks on the upper and lower edges of the tile.
1. Lower Metal Closure: Formed to match the contour of the tile and fits on top of the drip edge under the first course of tile to raise the lower edge to the correct height as well as keep out birds and insects.
 2. Upper Metal Closures: Secured via fastener over the fastener lugs in the barrels at the top of the tile to protect from birds, insects, and wind-driven rain.
 3. Color: Canyon Earth.
- D. Universal Tile Ridge Vent: Combines tile ventilation and expandable weather blocking with an aluminum closure system to attach to tile with a peel-off butyl adhesive.
1. Size (WxL): 15-3/74 inches x 16 ft.
 2. Color: Terra Cotta.
- E. Quarrix Universal Tile Flashing: Fully adhered, expandable aluminum flashing that can be used as a primary flashing and counter flashing, in combination with bent metal flashings, or as a weather block wherever mortar would be required.
1. Size (WxL): 11-3/4 inches x 16 ft.
 2. Color: Terra Cotta.
- F. Fasteners:
1. Tile Fasteners:
 - a. Quarrix Tile Fasteners: Corrosion resistant exterior grade screws for specialty roof applications and recommended with Quarrix Composite Tile.
 - 1) Tested to SAE J78 with 2-3/4 inch (70 mm) overall length, 1-1/2 inch (38 mm) thread length, No. 10 pan-head (0.40 inch) screws. Two per tile.
 - b. Screw Fasteners: Use screws for maximum wind resistance.
 - 1) Two, 2-3/4 inch (6.98 cm), non-corrosive No. 10 coarse thread, 0.344 inch diameter (8.74 mm) pan-head screws.
 - a) This allows for 1/4 inch (6 mm) penetration through sheathing.
 2. Batten Fasteners: Fastened every 10 inches (254 mm) using non-corrosive nails or screws of sufficient length to fully penetrate roof sheathing.
 3. Underlayment Fasteners: 11-ga roofing nails with 3/8 inch (10 mm) heads of sufficient length to penetrate sheathing 3/8 inch (10 mm) or through sheathing 3/4 inch (19 mm), whichever is less.
 4. Flashing Fasteners: 11 ga, ring-shank, corrosion-resistant nails compatible with flashing material with sufficient length to penetrate sheathing 3/4 inch (19 mm) or through the sheathing, whichever is less.
 5. Fasteners for Hip, Ridge and Rake Tiles and Hip Starter Tiles: Use Quarrix Tile Fasteners for hip, ridge, and rake tiles where applicable and when possible.
 - a. When Other Fasteners are Needed:
 - 1) No. 10, coarse-thread, 0.344 inch diameter (8.74 mm), corrosion-resistant pan-head screws; same as tile fasteners.
 - a) For Ridges and Hips: 2-3/4 inches (70 mm) long.
 - 2) 3 inch (76 mm) non-corrosive, ring-shank nail in combination with an approved adhesive under the nose of each trim piece can also be used.
- G. Adhesives: Titebond. A roofing adhesive compatible with high-density polyethylene (HDPE).
1. To secure cut pieces of field tile along hips, valleys, flying gables, and protrusions and

to install hip, ridge, and rake tiles.

- H. Metal Flashings:
 - 1. General Requirements: Form flashings to profiles indicated on Drawings, in accordance with manufacturer's printed instructions, and as recommended by SMACNA Architectural Sheet Metal Manual to protect materials from physical damage and to shed water.
 - a. Form flashing lengths square, accurate to profile, in maximum lengths; form flashing lengths free from distortion or defects detrimental to appearance or performance.
 - b. Hem edges of flashings exposed to view a minimum 1/4 inch (6 mm) on underside.
 - 2. Eave Flashings and Other Metal Flashings: 24 ga galvanized steel sheet, ASTM A653/A653M, minimum G90/Z275 hot-dip zinc coating.
 - 3. Concealed Sealants: For along gable rakes, ridge/hip trim and flashings with asphalt saturated felt underlayment.
 - a. Sealants: Non-running, heavy body Plastic Roof Cement that meets requirements of ASTM D2822 and Federal Specifications SS-S-153C (Type 1) or equal.
 - b. For EPDM or Synthetic Underlayment:
 - 1) Sealants: Per manufacturer's recommendation.
 - 4. Exposed Sealants: For counter flashings or non-soldered joints.
 - a. Sealants: Meet requirements of U.S. TT-S- 00230C, U.S. Fed Cat. No 8030-965-2397, Canadian 19-HP-5M, and ASTM C 290.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. Verify roof deck structure meets roof tile manufacturer's installation requirements.
 - 1. Roof penetrations are in place and flashed to deck surface.
 - 2. Roof openings are correctly framed prior to installing Work of this section.
 - 3. Deck is of sufficient thickness to accept fasteners.
 - 4. Deck surfaces are dry, unfrozen, and free of ridges, warps, and voids.
- C. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Broom clean deck surfaces prior to installation of underlayment.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Coordinate with installation of gutters, vents, skylights, and other adjoining work to ensure proper sequencing. Do not install roofing materials until all vent stacks and other penetrations through roof sheathing have been installed and securely fastened.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper

relationship with adjacent construction.

1. Arrange three or more stacks of roof tile at installation area; mix tile from stacks as installation progresses for consistent color blend.
 2. Do not overload roof surface with staged materials.
 3. Tile must be installed on roof slope of 4/12 or greater. Slopes of 3/12 or less will require alternative roof covering materials.
 4. Quarrix Double Roman Composite Tile cannot be installed on curved surfaces, these areas will require an alternative roof covering material.
- B. Install roof tile in accordance with shop drawings, Manufacturer's printed installation instructions for specified project conditions and the following:
1. ICC-ES -AC07.
 2. WSRCA/TRI Concrete and Clay Roof Tile Installation Manual for Moderate Climate Regions.
 3. WSRCA/TRI Standard Installation Guide for Concrete and Clay Roof Tile in Cold Weather Applications.
 4. FRSA/TRI Concrete and Clay Roof Tile Installation Manual for Florida High Wind Applications.
 5. NRCA Steep Slope Roofing Manual.
 6. SMACNA Architectural Sheet Metal Manual.
- C. Metal Eave Flashings: Install flashing 1/8 inch (3 mm) beyond fascia. Lap end joints a minimum 3 inches (76 mm), with plastic cement seal between overlapping metal surfaces.
1. Apply self-seal membrane over eave flashing parallel to eave edge in accordance with manufacturer's printed instructions.
 2. Extend self-seal membrane up roof slope minimum 2 ft (610 mm) beyond interior face of exterior wall or as required by code, whichever is greater.
 3. Place each successive ply overlapping top edge of previous ply 3 inches (76 mm).
- D. Valley Flashings: Install 24 to 28 inch (610 to 711 mm) standing seam, double rib, for closed valleys. or 24 inch (610 mm) double rib valley flashing, for open grouted valleys.
1. Form flashings in accordance with manufacturer's instructions for valley type indicated.
 2. Apply flashing over 36 inch (914 mm) full width vertical underlayment centered in all valley areas.
 3. Install flashings centered on valley; nail in place at 12 inches (305 mm) on center, 1 inch (25 mm) from metal edges.
 4. Roof Pitch 4 in 12 or Greater: Lap flashing end joints minimum 4 inches (102 mm).
 5. Roof Pitch Less Than 4 in 12: Lap flashing end joints minimum 6 inches (152 mm).
 6. For slopes below 3:12 or 4:12 in severe weather areas, install flashings and EPDM underlayment per details provided by the Manufacturer.
- E. Sidewall Flashings: Coordinate with installation of sidewall flashings specified in Section 076200.
- F. Synthetic Underlayment:
1. Use self-sealing membrane. Meets requirements of ICC-ES 48 along roof perimeters and protrusions.
 - a. Install parallel to roof eave with a 6 inch (152 mm) lap on the ends, a 3 inch (76 mm) side lap and a minimum 1/4 inch (6 mm) lap over eaves.
 2. Class C: ICC-ES, Self-Sealing Membrane:
 - a. Up Roof Deck: 2 ft (610 mm) inside exterior wall.
 - b. Valleys: 6 ft (1.829 m).
 - c. Around Protrusions, Gables, Walls and Under Valley Flashings: 3 ft (914 mm)

- d. For better protection, smaller roofs, and lower slopes, self-sealing membrane may be used on entire roof deck.
 - 1) High temperature underlayment is not required but may enhance performance.
 - 2) Heavy granulated underlayment is not recommended.
 - e. Install self-adhering sheet underlayment, wrinkle free, on plywood sheathing under composite roof tiles. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof, in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
- G. Intersections of Roof Surfaces and Abutting Vertical Surfaces:
- 1. Install continuous 36 inch (914 mm) wide strips of self-seal membrane to extend 30 inches (762 mm) across roof deck and 6 inches (152 mm) up vertical surface.
 - 2. Install continuous metal flashing to extend 3 inches (76 mm) up vertical surface.
 - 3. At locations where vertical surface will abut top edge of tile, install metal flashing to extend 3 inches (76 mm) up vertical surface, form metal flashing to extend minimum 3 inches (76 mm) over tile, and form 1/2 inch (13 mm) return hem at edge of metal.
 - 4. Form saddle flashings for protrusions through roof in accordance with manufacturer's printed instructions.
- H. Ridge Vent: Install in accordance with manufacturer's printed instructions.
- 1. Apply Quarrix Universal Tile Ridge Vent or Quarrix Universal Flashing to the ridge.
 - 2. Center vent on the ridge and loosely form the material to the tile roof surface.
 - 3. Determine how much vent you want exposed or concealed and snap horizontal lines accordingly.
 - 4. Overlap any rolls by 3 inch (76 mm).
 - 5. Remove the protective strip and firmly press into the tiles.
- I. Tile Battens:
- 1. Align the batten along the pre-chalked line.
 - 2. Never space battens more than 13-1/2 inches (89 mm) apart.
 - 3. Nail or screw battens 2 inches (51 mm) from each end.
 - 4. Nail or screw battens every 10 inches (254 mm).
 - 5. Quarrix Tile Battens are not structural support for the tile.
 - 6. Tile Fasteners: Need to penetrate roof deck through the battens by a minimum of 3/4 inch (19 mm).
 - 7. A utility knife can be used for cutting battens.
 - 8. When applying battens, install one roof plane at a time. Do not leave battens exposed an extended period to heat and sun as movement may occur prior to being covered by the tile.
- J. Eave Flashings: Install flashing 1/8 inch (3 mm) beyond the fascia. Lap end joints 3 inches (76 mm), with plastic cement seal between overlapping metal surfaces.
- 1. Apply self-seal membrane over eave flashing parallel to eave edge in accordance with manufacturer's printed instructions.
 - 2. Extend self-seal membrane up roof slope 2 feet (610 mm) beyond interior face of exterior wall or as required by code, whichever is greater.
 - 3. Place each successive ply overlapping top edge of previous ply 3 inches (76 mm).
- K. Fasteners: Install in accordance with Manufacturer's printed instructions.

- L. Roof Tile:
 - 1. Install tile right to left, as viewed facing ridge.
 - 2. Install closure strips in accordance with manufacturer's printed instructions for project conditions.
 - 3. Fasten tiles to battens with two, Quarrix High-Low Roofing Screws, 2.75 inch No. 10 pan-head, 0.40 inch screws per tile.
 - 4. Fasten tiles to battens with two, 2 inch (51 mm) 10 or 11 ga ring shank 3/8 inch diameter nails and 13-1/2 inches (343 mm) exposure.
 - 5. Cut tile, as tile installation progresses, for hip, valley, and wall conditions.
 - 6. Partial Tiles: Secure at two points or by two methods; screws, wires, adhesives, and clips.

- M. Install venting as tile installation progresses. Locate in accordance with manufacturer's instructions.

- N. Trim:
 - 1. Install trim for hips, ridges, and rakes as tile installation progresses. Cut shapes, set in bed of plastic roof cement, and secure in place with minimum 2 fasteners per piece for rake trim, and minimum 1 fastener per piece for hip and ridge trim.
 - 2. Cut special shapes for project conditions as required.
 - 3. Overlap trim piece ends 3 inches (76 mm). Seal overlapping surfaces with approved adhesives.

- O. Counter Flashings:
 - 1. Install counter flashings tight to substrates, with top edge of counter flashing concealing base flashings; lap end joints minimum 3 inches (76 mm).
 - 2. Fasten counter flashings using specified fasteners; fasten on vertical surfaces only, at maximum spacing 12 inches (305 mm) on center.

3.4 CLEANING AND PROTECTION

- A. Protect installed products until completion of project.
- B. Clean products in accordance with the Manufacturer's recommendations.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 073200

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING

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. Mechanically fastened membrane roofing system.
 - 2. Roof Insulation.
 - 3. Walkways.
- B. This Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking."
- C. Related Sections include the following:
 - 1. Division 05 Section "Steel Decking".
 - 2. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking and for wood-based, structural-use roof deck panels.
 - 3. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
 - 4. Division 07 Section "Joint Sealants."
 - 5. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.
 - 6. Division 03 Section "Cast in Place Concrete".

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.
- C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.
 - 1. Corner Uplift Pressure: See drawings.
 - 2. Perimeter Uplift Pressure: See drawings.
 - 3. Field-of-Roof Uplift Pressure: See drawings.
- D. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
 - 1. Fire/Windstorm Classification: Class 1A- 90.
 - 2. Hail Resistance: SH.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Insulation fastening patterns.
 - 4. Crickets, Saddles, and tapered edge strips.
- C. Samples for Verification: For the following products:
 - 1. 12-by-12-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. 12-by-12-inch square of roof insulation.
 - 3. 12-by-12-inch square of walkway pads or rolls.
 - 4. 12-inch length of metal termination bars.
 - 5. Six roof cover fasteners of each type, length, and finish.
 - 6. Walkway pads or rolls, of color required.

- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- F. Qualification Data: For Installer and manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- H. Research/Evaluation Reports: For components of membrane roofing system.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Special warranties specified in this Section.
- K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty. Installer must be certified by manufacturer as Top-Tier Authorized installer. Installer has been in business under the same name for a minimum of 5 years.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain components for membrane roofing system from roofing membrane manufacturer.
- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 - 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

- F. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
 10. Roof membrane installer must accept deck in writing prior to installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, non prorated, edge to edge warranty, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, walkway products and other components of membrane roofing system including penetrations, curbs, drains, metal flashings, drain hubs, and parapet caps and flashing.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: 5 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 for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PVC ROOFING MEMBRANE

- A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced.
 - 1. Manufacturers:
 - a. Duro-Last Roofing, Inc.

- b. Johns Manville International, Inc., KEE
 - c. Sarnafil Inc., S or G.
 - d. Fiber-Tite
- 2. Thickness: 60 mils, minimum.
 - 3. Exposed Face Color: White, Energy Star.

2.3 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard solvent-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.4 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers:
 - a. Apache Products Company.
 - b. Atlas Roofing Corporation.
 - c. Celotex Corporation.
 - d. Firestone Building Products Company.

- e. GAF Materials Corporation.
 - f. Honeywell Commercial Roofing Systems.
 - g. Hunter Panels, LLC.
 - h. Johns Manville International, Inc.
 - i. Koppers Industries.
 - j. RMAX.
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
- D. Insulation Cant Strips: ASTM C 728, perlite insulation board.
- E. Wood Nailer Strips: Comply with requirements in Division 06 Section "Rough Carpentry."
- F. Tapered Edge Strips: ASTM C 728, perlite insulation board.
- G. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 5/8 inch thick.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [CertainTeed Corporation](#); GlasRoc Sheathing Type X.
 - b. [Georgia-Pacific Corporation](#); Dens Deck DuraGuard.
 - c. [National Gypsum Company](#); Gold Bond eXP Extended Exposure Sheathing.
 - d. [USG Corporation](#); Securock Glass Mat Roof Board.
- H. Substrate Joint Tape: 6- or 8-inch- wide, coated, glass-fiber joint tape.
- I. Metal Securement System: Perimeter securement flashing and strapping fabricated from stainless steel, a minimum of 0.031 inch thick. Provide fasteners as recommended by mortar-faced insulation manufacturer.

2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch-thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches.
 - 2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking".
 - 4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
 - 5. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 6. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than **75** percent, or as recommended by roofing system manufacturer, when tested according to ASTM F 2170.
 - a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with no fewer than three test probes.
 - b. Submit test reports within 24 hours of performing tests.
 - 7. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - 8. Verify that minimum curing period recommended by roofing system manufacturer for concrete roof decks has passed.
 - 9. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 10. Roof membrane installer must accept roof deck in writing prior to installation.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- B. Install one lapped base sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
- C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.
- D. Install tapered insulation under area of roofing to conform to slopes indicated.
- E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- F. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 2. Install subsequent layers of insulation in a solid mopping of hot roofing asphalt.
- J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing system manufacturer.

1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
2. Apply hot roofing asphalt to underside and immediately bond cover board to substrate.

3.4 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
 1. Install sheet according to ASTM D 5082.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
- G. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- H. In-Splice Attachment: Secure one edge of roofing membrane using fastening plates or metal battens centered within membrane splice and mechanically fasten roofing membrane to roof deck. Field-splice seam.
- I. Through-Membrane Attachment: Secure roofing membrane using fastening plates or metal battens and mechanically fasten roofing membrane to roof deck. Cover battens and fasteners with a continuous cover strip.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
 - 1. Install flexible walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
 - 2. Provide 6-inch clearance between adjoining pads.
 - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer Field Service: Engage a factory authorized service representative to inspect installation. Report results in writing. Provide a minimum of 4 visits; 1) pre-installation meeting, 2) beginning of installation, 3) mid-term installation, 4) final inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for

deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean and wash entire roof membrane of overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075400

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manufactured Products:
 - a. Manufactured reglets and counterflashing.
2. Formed Products:
 - a. Formed roof drainage sheet metal fabrications.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Formed equipment support flashing.

B. Related Sections:

1. Division 6 Section "Rough Carpentry for wood nailers, curbs, and blocking.
2. Division 7 Section "Membrane Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
3. Division 7 Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
 1. Wind Zone 1: As indicated on drawings.
 2. Wind Zone 2: As indicated on drawings.
 3. Wind Zone 3: As indicated on drawings.
 4. All edge flashing and parapet copings must be ES-1 rated.

- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - 7. Details of special conditions.
 - 8. Details of connections to adjoining work.
 - 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 - 3. Accessories and Miscellaneous Materials: Full-size Sample.
- D. Qualification Data: For qualified fabricator.
- E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
 - 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

- B. Coordination with PVC Roof: All low-slope metal flashings associated with PVC membrane roofing must be installed by PVC membrane installer and covered under the PVC membrane edge-to-edge warranty. This includes flashing, counter flashing copings, roof edge flashing, roof penetrations and roof drains.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Surface: Smooth, flat.
 - 2. Factory Prime Coating: Where painting after installation is indicated, pretreat with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil.
 - 3. Exposed Coil-Coated Finishes:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 4. Color: As selected by Architect from manufacturer's full range.
 - 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
 - 2. Surface: Smooth, flat..
 - 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 4. Color: As selected by Architect from manufacturer's full range.

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
 1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products Inc.
 - d. Hickman, W. P. Company.
 - e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - f. Keystone Flashing Company, Inc.
 - g. National Sheet Metal Systems, Inc.
 - h. Sandell Manufacturing Company, Inc.
 - 2. Material: Aluminum, 0.024 inch thick or Galvanized steel, 0.022 inch thick.
 - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 6. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
 - 7. Finish: Manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- I. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion

joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Gutter Style: As indicated on drawings.
 2. Expansion Joints: Lap type.
 3. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen.
 4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Aluminum: 0.040 inch thick.
- B. Downspouts: Fabricate rectangular open downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Hanger Style: Manufacturer's standard.
 2. Fabricate from the following materials:
 - a. Aluminum: 0.024 inch thick.
- C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.
- D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
1. Aluminum: 0.032 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing (Drip Edge) and Fascia Cap: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Furnish with 6-inch- wide, joint cover plates.
1. Joint Style: Lap, 4 inches.
 2. Fabricate with scuppers spaced 10 feet apart, of dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten guard angles to base of scupper.
 3. Fabricate from the following materials:
 - a. Aluminum: 0.040 inch thick.
- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support

edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Coping Profile: See drawings.
2. Joint Style: Butt, with 12-inch- wide, concealed backup plate and 6-inch- wide, exposed cover plates.
3. Fabricate from the following materials:
 - a. Galvanized Steel: 0.028 inch thick.

C. Base Flashing: Fabricate from the following materials:

1. Aluminum: 0.040 inch Insert thickness thick.

D. Counterflashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Galvanized Steel: 0.022 inch thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

G. Roof-Drain Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.

7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel and aluminum sheet.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- F. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored

gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Loosely lock straps to front gutter bead and anchor to roof deck.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 40 feet apart. Install expansion-joint caps.
5. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system indicated.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant compatible with roofing membrane.

E. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

F. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper discharge.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing ES-1 Rated: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

- C. Copings ES-1 Rated: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means interlocking folded seam or blind rivets and sealant.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member. Slip flash all curbs.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Roof hatches.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Division 5 Section "Pipe and Tube Railings" for safety railing system not attached to roof hatch curbs.
 - 3. Division 6 Section "Rough Carpentry" for wood cants, and wood nailers.
 - 4. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.

3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
- D. Samples: For each type of exposed factory-applied **color** finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.8 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof accessories 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: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

- A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coated.
 - 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coated.
 - 3. Exposed Finishes: High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in AAMA 2604, except as modified below:
 - 1) Humidity Resistance: 2000 hours.
 - 2) Salt-Spray Resistance: 2000 hours.
- B. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and finish. Coil-coat finish as follows:
 - 1. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturer's written instructions.
 - a. Color and Gloss: Match Architect's sample.
- C. Aluminum Extrusions and Tubes: ASTM B 221, alloy and temper recommended by manufacturer for type of use, mill finished.
- D. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.

- E. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.
- F. Steel Tube: ASTM A 500, round tube, baked-enamel finished.
- G. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.
- H. Galvanized Steel Pipe: ASTM A 53/A 53M.

2.3 MISCELLANEOUS MATERIALS

- A. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, 1 inch thick.
- B. Glass-Fiber Board Insulation: ASTM C 726, 1 inch thick.
- C. Polyisocyanurate Board Insulation: ASTM C 1289, 1 inch thick.
- D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWWA C2; not less than 1-1/2 inches thick.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Polyethylene Sheet: 6-mil - thick, polyethylene sheet complying with ASTM D 4397.
- G. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.
- H. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C 920, silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- K. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- L. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.4 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
1. Manufacturers:
 - a. Colony Custom Curbs.
 - b. Commodity Products Company, Inc.
 - c. Conn-Fab Sales, Inc.
 - d. Curbs Plus Inc.
 - e. Custom Curb, Inc.
 - f. LM Curbs.
 - g. Loren Cook Company.
 - h. Metallic Products Corporation.
 - i. Pate Company (The).
 - j. Roof Products & Systems Corporation.
 - k. Roof Products, Inc.
 - l. Thaler Metal Industries Ltd.
 - m. ThyCurb; Div. of Thybar Corporation.
 - n. Uni-Curb, Inc.
 - o. Vent Products Company, Inc.
 2. Material: Aluminum sheet, 0.090 inch thick.
 - a. Finish: High-performance organic coating.
 3. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 4. Factory install wood nailers at tops of curbs.
 5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 6. Factory insulate curbs with 1-1/2-inch - thick, cellulosic or glass-fiber board insulation.
 7. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches unless otherwise indicated.
 8. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.5 EQUIPMENT SUPPORTS

- A. Equipment Supports: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Manufacturers:
 - a. Colony Custom Curbs.
 - b. Commodity Products Company, Inc.
 - c. Conn-Fab Sales, Inc.
 - d. Curbs Plus Inc.
 - e. Custom Curb, Inc.
 - f. LM Curbs.
 - g. Loren Cook Company.
 - h. Metallic Products Corporation.
 - i. Pate Company (The).
 - j. Roof Products & Systems Corporation.
 - k. Roof Products, Inc.
 - l. Thaler Metal Industries Ltd.
 - m. ThyCurb; Div. of Thybar Corporation.
 - n. Uni-Curb, Inc.
 - o. Vent Products Company, Inc.
2. Material: Aluminum sheet, 0.090 inch thick.
 - a. Finish: High-performance organic coating.
3. Factory-install continuous wood nailers 3-1/2 inches wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
7. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.6 ROOF HATCHES

- A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated single double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Manufacturers:
 - a. Babcock-Davis; a Cierra Products Inc. Company.
 - b. Bilco Company (The).
 - c. Bristolite Skylights.
 - d. Custom Curb, Inc.
 - e. Dur-Red Products.
 - f. Hi Pro International, Inc.
 - g. J. L. Industries, Inc.
 - h. Metallic Products Corporation.

- i. Milcor Inc.; a Gibraltar Company.
 - j. Nystrom, Inc.
 - k. O'Keeffe's Inc.
 - l. Precision Ladders, LLC.
 - m. Roof Products & Systems Corporation.
 - n. ThyCurb; Div of Thybar Corporation.
 - o. Wasco Products, Inc.
 - p. Western Canwell.
2. Type and Size: Single-leaf lid, 30 by 36 inches.
 3. Curb and Lid Material: Aluminum sheet, 0.090 inch thick.
 - a. Finish: High-performance organic coating.
 4. Insulation: Cellulosic-fiber, Glass-fiber or Polyisocyanurate board.
 5. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
 6. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
 7. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 8. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
 9. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units.
 10. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by 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 exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Roof Curb Installation:
 - 1. Set roof curb so top surface of roof curb is level.
 - 2. Install weather stripping on top of curb.
- F. Equipment Support Installation:
 - 1. Set equipment support so top surface of equipment support is level.
- G. Roof Hatch Installation:
 - 1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
- H. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

SECTION 078100 - SPRAYED FIRE-RESISTIVE MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed SFRM.
 - 2. Exposed SFRM.
- B. Related Sections include the following:
 - 1. Division 5 Section "Structural Steel" for surface conditions required for structural steel receiving SFRM.
 - 2. Division 7 Section "Building Insulation" for fire-safing insulation.
 - 3. Division 7 Section "Through-Penetration Firestop Systems" for fire-resistance-rated firestopping systems.
 - 4. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistance-rated joint systems.

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive material.
- B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed and have not been defined as exposed.
- C. Exposed: Fire-resistive materials applied to surfaces that are exposed to view when the Work is completed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying SFRM.
 - 2. Extent of SFRM for each construction and fire-resistance rating, including the following:

- a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1) For steel joist assemblies, include applicable fire-resistance design designations, with each steel joist tested with the same maximum tensile stress as each steel joist indicated on Drawings. Design designations with steel joists tested at lower maximum tensile stress than those indicated are not permitted.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
3. Treatment of SFRM after application.
- C. Samples for Initial Selection: For each type of colored, exposed SFRM indicated.
 - D. Samples for Verification: For each type of colored, exposed SFRM, two Samples, each 4 inches square, of each color, texture, and material formulation to be applied. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - E. Product Certificates: For each type of SFRM, signed by product manufacturer.
 - F. Qualification Data: For Installer, manufacturer, professional engineer, and testing agency.
 - G. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
 - 1. Materials have been tested for bond with substrates.
 - 2. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
 - 3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.
 - I. Research/Evaluation Reports: For SFRM.
 - J. Field quality-control test and special inspection reports.
 - K. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to

Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

- B. Source Limitations: Obtain SFRM through one source from a single manufacturer.
- C. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 - 1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
 - 3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- D. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
 - 1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.
- E. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" acceptable to authorities having jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
 - 2. Surface-Burning Characteristics: ASTM E 84.
- F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- G. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Extent of Mockups: Approximately 100 sq. ft. of surface for each product indicated.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to SFRM including, but not limited to, the following:
1. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thicknesses, bond strengths, and other performance requirements.
 2. Review and finalize construction schedule and verify sequencing and coordination requirements.
 3. Review weather predictions, ambient conditions, and proposed temporary protections for SFRM during and after installation.
 4. Review surface conditions and preparations.
 5. Review field quality-control testing procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 40 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 COORDINATION

- A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:
 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.

3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Concealed Cementitious SFRM:
 - a. Carbolite Co., Fireproofing Products Div.; Pyrolite 15 High Yield.
 - b. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6.
 - c. Isolatek International Corp.; Cafco 300.
 - d. Southwest Vermiculite Co., Inc.; Type 5.
 - e. Carbolite Co., Fireproofing Products Div.; Pyrolite 15 Blue.

- f. Grace, W. R. & Co. - Conn., Construction Products Div.; Retro-Gard.
 - g. Isolatek International Corp.; Cafco 300 SB.
 - 2. Concealed Sprayed-Fiber Fire-Resistive Material:
 - a. Isolatek International Corp.; Cafco Blaze-Shield II.
- B. Material Composition: Manufacturer's standard product, or either of the following:
 - 1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
 - 2. Concealed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
 - 1. Dry Density: 15 lb/cu. ft. for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 - 2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605:
 - a. Where the referenced fire-resistance design lists a thickness of 1 inch or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch.
 - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of SFRM is the greater of 0.375 inch or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft..
 - 3. Bond Strength: 150 lbf/sq. ft. minimum per ASTM E 736 based on laboratory testing of 0.75-inch minimum thickness of SFRM.
 - 4. Compressive Strength: 5.21 lbf/sq. in. minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch and minimum dry density shall be as specified but not less than 15 lb/cu. ft..
 - 5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
 - 6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
 - 7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
 - 8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 0.
10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 EXPOSED SFRM

A. Products: Subject to compliance with requirements, provide one of the following:

1. Exposed Cementitious SFRM:

- a. Carbolite Co., Fireproofing Products Div.; Pyrolite 22.
- b. Carbolite Co., Fireproofing Products Div.; Pyrocrete 239.
- c. Carbolite Co., Fireproofing Products Div.; Pyrocrete 40.
- d. Carbolite Co., Fireproofing Products Div.; Pyrocrete 240 High Yield.
- e. Carbolite Co., Fireproofing Products Div.; Pyrocrete 241.
- f. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106G.
- g. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106.
- h. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z106/HY.
- i. Grace, W.R. & Co. - Conn., Construction Products Div.; Monokote Type Z146.
- j. Isolatek International Corp.; Cafco 400.
- k. Isolatek International Corp.; Fendolite M-II.
- l. Pyrok, Inc.; Pyrok-HD.
- m. Pyrok, Inc.; Pyrok-MD.
- n. Southwest Vermiculite Co., Inc.; 5MD.
- o. Southwest Vermiculite Co., Inc.; 7GP.
- p. Southwest Vermiculite Co., Inc.; 1XR.

2. Exposed Sprayed-Fiber Fire-Resistive Material:

- a. Isolatek International Corp.; Cafco Blaze-Shield HP.

B. Material Composition: Manufacturer's standard product, as follows:

1. Exposed Cementitious SFRM: Factory-mixed, dry, cement aggregate formulation; or chloride-free formulation of gypsum or portland cement binders, additives, and inorganic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
2. Exposed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.

- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method," but with an average density of not less than 22 lb/cu. ft..
 2. Bond Strength: 434 lbf/sq. ft. minimum per ASTM E 736.
 3. Compressive Strength: 51 lbf/sq. in. minimum per ASTM E 761.
 4. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
 5. Deflection: No cracking, spalling, or delamination per ASTM E 759.
 6. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.
 7. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E 859.
 8. Combustion Characteristics: Passes ASTM E 136.
 9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 0.
 10. Fungal Resistance: No observed growth on specimens per ASTM G 21.
 11. For exterior applications of SFRM, provide formulation listed and labeled by testing and inspecting agency acceptable to authorities having jurisdiction for surfaces exposed to exterior.

2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM 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: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive SFRM.

- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of intumescent mastic coating fire-resistive material. Include pins and attachment.
- G. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
 - 1. Product: Subject to compliance with requirements, provide "Cafco Bond-Seal" by Isolatek International Corp.
- H. Topcoat: Type recommended in writing by manufacturer of each SFRM for application over concealed and exposed SFRM.
- I. Cement-Based Topcoat: Factory-mixed, cementitious hardcoat formulation recommended in writing by manufacturer of SFRM for trowel or spray application over concealed and exposed SFRM.
 - 1. Product: Subject to compliance with requirements, provide "Hardcoat 4500" by Carbolite Co.; Fireproofing Products Div. or "Cafco 800" by Isolatek International Corp.
- J. Water-Based Permeable Topcoat: Factory-mixed formulation recommended in writing by manufacturer of SFRM for brush, roller, or spray application over concealed and exposed SFRM. Provide application at a rate of 120 sq. ft./gal.
 - 1. Product: Subject to compliance with requirements, provide "Cafco Topcoat" by Isolatek International Corp.

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 work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Verify that concrete work on steel deck has been completed.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.
- D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Install metal lath and reinforcing fabric, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.

- D. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.
- E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.
- G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply SFRM that differs in color from that of encapsulant over which it is applied.
- H. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.

3.4 APPLICATION, CONCEALED SFRM

- A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.
- B. Apply water overspray to concealed sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating and where indicated.
- C. Cure concealed SFRM according to product manufacturer's written recommendations.
- D. Apply sealer or topcoat to concealed SFRM as required by manufacturer.

3.5 APPLICATION, EXPOSED SFRM

- A. Apply exposed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if indicated.
 - 1. For steel beams and bracing, provide a thickness of not less than 1 inch.
 - 2. For metal floor or roof decks, provide a thickness of not less than 1/2 inch.
- B. Provide a uniform finish complying with description indicated for each type of material and matching Architect's sample or, if none, finish approved for field-erected mockup.
- C. Apply exposed cementitious SFRM to produce the following finish:
 - 1. Spray-textured finish with no further treatment.

2. Even, spray-textured finish, produced by rolling flat surfaces of fire-protected members with a damp paint roller to remove drippings and excessive roughness.
 3. Skip-troweled finish with leveled surface, smoothed-out texture, and neat edges.
 4. Smooth, troweled finish with surface markings eliminated and edges squared.
- D. Apply exposed sprayed-fiber fire-resistive material to produce the following finish:
1. Spray-textured finish.
- E. Cure exposed SFRM according to product manufacturer's written recommendations.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspection and prepare reports:
1. SFRM.
- B. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
 2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
 3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
 - a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
 - b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. minimum per ASTM E 736.

5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- C. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- D. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

3.7 CLEANING, PROTECTING, AND REPAIR

- 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. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.
- D. Repair or replace work that has not successfully protected steel.

END OF SECTION 078100

SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS

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 through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
 - 1. Division 7 Section "Fire-Resistive Joint Systems."
 - 2. Division 21 Sections specifying fire-suppression piping penetrations.
 - 3. Division 23 Sections specifying duct and piping penetrations.
 - 4. Division 26 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provides products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace, W. R. & Co. - Conn.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. RectorSeal Corporation (The).
 - 8. Specified Technologies Inc.
 - 9. 3M; Fire Protection Products Division.
 - 10. Tremco; Sealant/Weatherproofing Division.
 - 11. USG Corporation.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved

by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- I. Silicone Foams: Multi-component, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a non-slumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
 - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fire-resistive joint systems for the following:
 - 1. Floor-to-floor joints.
 - 2. Floor-to-wall joints.
 - 3. Head-of-wall joints.
 - 4. Wall-to-wall joints.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for systems installed in openings in walls and floors with and without penetrating items.
 - 2. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, as determined by UL 2079.
 - 1. Load-bearing capabilities as determined by evaluation during the time of test.
- C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.
- C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.
- D. Qualification Data: For Installer.
- E. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.
- F. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer,

date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the fire-resistive joint systems indicated for each application that are produced by one of the following manufacturer's:
 - 1. A/D Fire Protection Systems Inc.
 - 2. Grace, W.R. & Co. – Conn.
 - 3. EMSEAL
 - 3. Hilti, Inc.
 - 4. Johns Manville
 - 5. Nelson Firestop Products.
 - 6. NUCO Inc.
 - 7. RectorSeal Corporation (The).
 - 8. Specified Technologies Inc.
 - 9. 3M; Fire Protection Products Division.
 - 10. Tremco; Sealant/Weatherproofing Division.

11. USG Corporation.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

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 joint sealants for the following applications:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Joints between metal panels.
 - b. Joints between different materials listed above.
 - c. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - d. Other joints as indicated.
 - 2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. Other joints as indicated.
 - 3. Interior joints in the following horizontal traffic surfaces:
 - a. Control and expansion joints in tile flooring.
 - b. Other joints as indicated.
- B. Related Sections include the following:
 - 1. Division 2 Section "Pavement Joint Sealants" for sealing joints in pavements, walkways, and curbing.
 - 2. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
 - 3. Division 8 Section "Glazing" for glazing sealants.
 - 4. Division 9 Section "Ceramic Tile" for sealing tile joints.

5. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For Installer and testing agency.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Ten years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Single-Component Neutral-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Tremco; Spectrem 1 (Basic).
 - d. GE Silicones; SilPruf SCS2000.
 - e. Pecora Corporation; 864.
 - f. Pecora Corporation; 890.
 - g. Polymeric Systems Inc.; PSI-641.
 - h. Sonneborn, Division of ChemRex Inc.; Omniseal.
 - i. Tremco; Spectrem 3.
 - j. Dow Corning Corporation; 791.
 - k. Dow Corning Corporation; 795
 - l. GE Silicones; SilPruf NB SCS9000.
 - m. GE Silicones; UltraPruf II SCS2900.
 - n. Pecora Corporation; 865.
 - o. Pecora Corporation; 895.
 - p. Pecora Corporation; 898.
 - 2. Type and Grade: S (single component) and NS (non-sag).
 - 3. Class: 100/50.
 - 4. Use Related to Exposure: NT (non-traffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

- a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, marble, ceramic tile, and wood .
- 6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
- D. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Tremco; Tremsil 200.
 - 2. Type and Grade: S (single component) and NS (non-sag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (non-traffic).
 - 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, ceramic tile.

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
- B. Products:
 - 1. Bostik Findley; Chem-Calk 600.
 - 2. Pecora Corporation; AC-20+.
 - 3. Schnee-Morehead, Inc.; SM 8200.
 - 4. Sonneborn, Division of ChemRex Inc.; Sonolac.
 - 5. Tremco; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact 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.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Flush Wood Doors".
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors".
4. Division 08 Section "Door Hardware".
5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
6. Division 09 Sections "Non-Structural Metal Framing".
7. Division 09 Sections "Gypsum Board".
8. Division 26 "Electrical".
9. Division 27 "Communications".

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
17. IBC 2012.
18. ASCE7-10, Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
 9. Electrical Elevations for frames requiring prewire for the specified cables in Section 087100.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with one removable shipping spreader bars across bottom of frames, tack welded to jambs and mullions. The shipping spreader shall be removed prior to setting the frame.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CECO Door Products.
 2. Curries Company.
 3. Steelcraft.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for Level 3 and Model 2 Seamless and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel, seamless edges.
2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.7.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
6. Door Gauge: 16 gauge cold rolled steel, A60 galvanized, seamless.
7. Windload: Provide doors meeting the manufacturer's assembly testing for the buildings static design pressures for exterior components and cladding. These are minimum gauge requirements. However, this does not relieve the supplier from complying with the structural requirements with respect to the buildings static design pressures. Refer to the structural specifications and drawings for those requirements and provide the required gauge and door construction to meet those requirements, and provide the required gauge and door construction to meet those requirements.
8. Door Gauge: 16 gauge A60 galvanealed, seamless.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for Level 2 and Model 2 Seamless and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel, seamless edges.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
6. Door Gauge: 18 gauge cold rolled steel, seamless.

D. Manufacturers Basis of Design:

1. Curries Company 707 Series.
2. Curries Company Temperature Rise: 727, for hollow metal stair enclosure doors.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with die mitered interlocked corners.
 - 2. Frames shall be continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 - 3. All frames shall be 14 gauge cold rolled steel.
 - 4. Exterior frames shall be a minimum A60 galvanized.
 - 5. Windload: Provide frames meeting the manufacturer's assembly testing for the buildings static design pressures for exterior components and cladding. These are minimum gauge requirements. However, this does not relieve the supplier from complying with the structural requirements with respect to the buildings static design pressures. Refer to the structural specifications and drawings for those requirements.
 - 6. Manufacturers Basis of Design:
 - a. Curries Company M Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with die mitered interlocked corners.
 - 2. Frames shall be continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 - 3. Frames for Steel Doors: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 4. Frames for openings up to 48 inches in width: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.]
 - 5. Frames for Wood Doors: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
 - 6. Frames for Borrowed Lights: Minimum 16 gauge (0.053-inch-1.3-mm-) thick steel sheet.
 - 7. Manufacturers Basis of Design:
 - a. Curries Company M Series (Masonry Profile).
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 3. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 HOLLOW METAL FRAME AND DOOR CABLES

- A. Coordinate the frame and door cables specified in section 087100 with the hollow metal door and frames.
1. Frames: Frames shall have electrical boxes covering the locations of the current transfer devices (QC Hinges) and the Door Position Switches (3287) locations where specified in 087100. ½” Rigid conduit shall be attached to each of these boxes. This conduit shall extend 6” above the finished frame height. Cables shall be preinstalled into the hollow metal frames at these locations prior to delivering the frames to the project site. 4” cable lengths with associated Molex connections (QC Locations) shall be secured to the exposed stop of the frame. The balance of the cable length shall be neatly coiled as it exits the 6” conduit stub out of the top of the frame (Fig 1). The excess cable shall be neatly coiled and polybagged, then nested inside the header of the frame for deliver to the site. At all locations, where the conduit mechanically connects to the hollow metal frame electrical cover boxes, these joints shall be provided with a watertight seal.

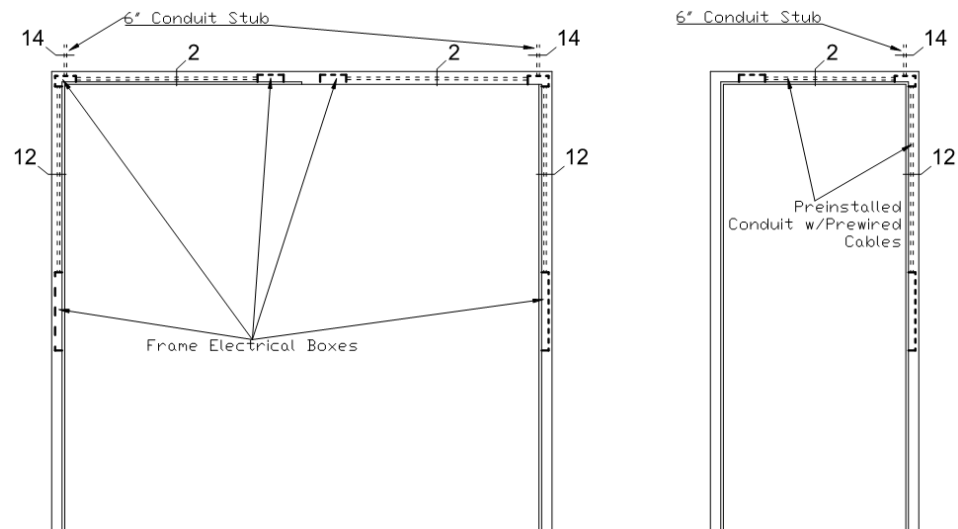


Figure 1.

2. Doors: Specified door cables in section 087100 shall be installed by the door manufacturer during the manufacturing process. Cables shall be nested inside the fabricated electrical pockets of the doors.

3. Elevations: Review the electrical drawings for elevation drawings of pathways to be provided.

2.7 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
 1. Blade Type: Vision proof inverted V or inverted Y.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
 3. Windstorm Rated: Provide exterior louvers, where required, to conform to the required static design pressures for the building.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.8 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed. Provide pockets in Lites suitable for the glass thickness specified in Division 08 Section "Glazing".
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.10 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit.
 - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with one steel spreader temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used as a setting spreader to size the frame opening. The shipping spreader must be removed prior to setting the frame.
 - 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 - 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
 - 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.11 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 1. Remove shipping spreaders from the frames. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jams and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Solid core doors with wood veneer.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Louvers installed in flush wood doors.
5. Light frames and glazing installed in wood doors.

- B. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
2. Division 08 Section "Glazing" for glass view panels in wood doors.
3. Division 08 Section "Door Hardware" for door hardware for flush wood doors and wood frames.
4. Division 26 "Electrical".
5. Division 27 "Communications"

- C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 – Wood Particleboard.
2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications. Include factory finishing specifications.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire protection ratings for fire rated doors.
- D. Samples for Initial Selection: For factory finished doors.
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
 - 2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.
- E. Warranty: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors'.

- C. Fire Rated Wood Doors: Doors 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 at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C (neutral pressure testing according to UL 10B where specified).
 - 1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
 - 2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
 - 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - 1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 - 4. Blocking: Indicate size and location of blocking in 45, 60 and 90 minute mineral core doors.
- D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package pre-finished doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
 - c. Telegraphing of core construction and delaminating of face in decorative laminate-faced doors.
 - 2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Graham Wood Doors; an Assa Abloy Group company.
 - 3. Marshfield Door Systems, Inc.; a Division of Masonite Architectural Door Systems.

2.2 DOOR CONSTRUCTION – GENERAL

- A. WDMA I.S.1-A Performance Grade: Heavy Duty; Aesthetic Grade: Premium.
- B. Fire Rated Doors: Provide construction and core as needed to provide fire ratings indicated.
 - 1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60, and 90 minute rated doors. Comply with specified requirements for exposed edges.
 - 2. 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.

2.3 CORE CONSTRUCTION

A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard, WDMA Performance Duty Level; Heavy Duty.
2. Adhesive: Per requirements of WDMA I.S. 1A, C-6.
3. Basis of Design:
 - a. Algoma: Novodor
 - b. Graham: GPD, PC5
 - c. Marshfield: DPC

B. Mineral Core Doors:

1. Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire protection rating indicated.
2. Edge Construction: At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance. Comply with specified requirements for exposed edges.
3. Basis of Design:
 - a. Graham GPD-FD.
 - b. Marshfield DFM.

C. Structural Composite Lumber Doors:

1. Where non rated door cutouts exceed 40% of the doors surface area, provide doors with a structural composite lumber core.

2.4 VENEERED DOORS FOR TRANSPARENT FINISH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Graham: GPD
2. Marshfield: Signature Series
3. Algoma: Novodor

B. Interior Solid Core Doors:

1. Assembly of Veneer Leaves on Door Faces:
 - a. Match: Center Balanced Match.

- b. Species: White Birch, rotary cut.
 - c. Grade: Grade A.
2. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 3. Transom Match: Continuous match.
 4. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
 5. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
 6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
 7. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.5 LOUVERS

- A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
 1. Blade Type: Vision proof inverted V or inverted Y.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.

2.6 LIGHT FRAMES AND GLAZING

- A. Wood Beads for Light Openings in non rated Wood Doors:
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard flush profile.
- B. Metal Frames for Light Openings in Fire Rated Doors 20-minute rating and greater: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.7 FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire rated doors.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
- D. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings:
 - a. Wood-Veneered Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated. Beads shall be of the same species specified for the door faces. Profile shall be flush rectangular beads.
 - b. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048 inch thick, cold rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.
 - 2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.
- E. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable. Provide factory installed cables where specified in 087100.

2.8 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

- B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.
 - 1. Grade: Premium.
 - 2. Finish: Meet or exceed WDMA I.S. 1A TR6 Catalyzed Polyurethane finish performance requirements.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Sheen: Satin.
 - 5. Color: As selected from the manufacturers standard color offering.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.
- C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 084113-R1 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Coordinate with section 087100 "Finish Hardware" in all aspects.
- C. Coordinate with Division 26, Electrical.
- D. Coordinate with Division 27, Communication.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior aluminum-framed storefront doors and windows.
 - a. Glazing is retained mechanically with gaskets on four sides.
 - b. Framing system is thermally broken.
- B. Related Sections include the following:
 - 1. Division 7 Section "Building Insulation" for insulation materials field installed with aluminum-framed systems.
 - 2. Division 7 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
 - 3. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - 4. Division 8 Section "Glazing" for glazing requirements to the extent not specified in this Section.
 - 5. Divisions 26 and 27 for access-controlled openings.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.

4. Dimensional tolerances of building frame and other adjacent construction.
 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units to function properly.
- B. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. Provide sealant that fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- C. Structural-Sealant Joints: Designed to produce tensile or shear stress in structural-sealant joints of less than 20 psi.
- D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch 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.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
 - H. Water Penetration Under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. In paragraph below, insert condensation-resistance requirements for venting windows or doors if required.
 - I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 48 when tested according to AAMA 1503.
 - J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.51 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
 4. All frames and doors requiring electrical raceways shall have elevation drawings provided showing the conductor path. It shall also show the required conductor counts for each run. A frame sample showing how this is achieved is required.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- E. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
 - 6. Wiring.
- F. Welding certificates.
- G. Certification demonstrating that the hardware installer is a factory authorized “Assa Abloy Certified Integrator.”
- H. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Accessible Entrances: Comply with Georgia Accessibility Code.
- D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."
- E. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing."
- F. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- G. “ASSA Abloy Certified Integrator” credentials.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components to function properly.
 - 2. Warranty Period: 5 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kawneer.
 - 2. Old Castle.
 - 3. YKK AP America Inc.
 - a. Basis of Design: YES 45 TU

4. Tubelite.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 Extruded Structural Pipe and Tubes: ASTM B 429.
 3. Structural Profiles: ASTM B 308/B 308M.
 4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard 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.
 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
- D. Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- E. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.
- F. Provide Manufacturer's flat filler pieces at head and jamb locations.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type and as follows:
 - 1. Structural Sealant: ASTM C 1184, neutral-curing silicone formulation compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant, and approved by structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. 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; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact; and recommended by structural- and weatherseal-sealant and aluminum-framed system manufacturers for this use.
 - a. Color: Matching structural sealant.

2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation, heavy duty, high traffic type, to match Basis of Design system specified.
 - 1. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration 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: Wide stile; 6-inch nominal width. Top rail shall have a minimum height of 8".
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide non-removable glazing stops on outside of door.

2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
- C. Conduit: Provide ½" diameter conduit attached to the framing system for the ElectroLynx cable pathway and Door Position Switch locations in the frames. Conduit and conduit connectors for electrical boxes shall be sealed against water penetration.
- D. Electrical Boxes: Provide electrical boxes for the attachment of the conduit for Harmony (H1) devices, electrified latch retraction devices, and door position switches. All of these electrical boxes shall be sealed against water penetration.

2.7 FABRICATION

- A. Form 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. Framing Members, General: 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. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior.
 7. 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. Door Frames: Reinforce as required to support loads imposed by door operation, for installing hardware and the installation of the ElectroLynx and Door Position Switch cables.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At all frames requiring electrical please provide in conformance with the NEC. Prewire frame members before installation. All wiring shall be concealed.

F. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.
3. Where electrical hardware devices are used, prewire the door and provide raceways as required for the hardware application.

G. Hardware Installation: Factory installed hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes. All Sargent Harmony exit devices shall be installed by a Assa Abloy Certified Integrator.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Exterior Storefront Systems: Color Anodic Finish, AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Bronze.

2.9 DOOR HARDWARE

A. General: Provide perimeter pile weather seals for all aluminum doors.

1. Refer to section 087100 for the balance of the hardware requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Electrical: During installation, coordinate directly with the Electrical Contractor for the installation of the preinstalled frame cables into the wall. Frames receiving Harmony and Door position switch cables; conduit in frames shall extend 6" above finished frame height. Electrical Contractor shall connect to the conduit stub up and provide the required pathway from the stub up to the terminal location of the cables which will be at the power supplies.

H. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

I. Install insulation materials as specified in Division 7 Section "Building Insulation."

- J. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
- K. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: 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 number of tests in areas as directed by Architect.
 - b. A minimum of 20 percent of all windows at each building shall be tested, as selected by the Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
 - 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION 084113

SECTION 084416-R1 - GLAZED ALUMINUM CURTAIN WALLS

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 glazed aluminum curtain walls.

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.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

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.
- C. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

1.7 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Special Assembly Warranty: Manufacturer or Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: 10 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. 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. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 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.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. 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.
- E. 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. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. 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..

- G. 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 6.24 lbf/sq. ft..
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
 2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
 2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.
- J. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.
- K. 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 0.45 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 0.35 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 15 as determined according to NFRC 500.
- L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows:
1. Outdoor-Indoor Transmission Class: Minimum 26.
- M. 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. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

- a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
- b. Low Exterior Ambient-Air Temperature: 0 deg F.

N. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.

O. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EFCO Corporation.
 2. Kawneer North America.
 3. Oldcastle, Inc.
 4. YKK AP America Inc., Basis of Design.
- B. Source Limitations: Obtain all components of curtain wall system, including framing spandrel panels and accessories, from single manufacturer.
- C. Basis of Design Product: YKK AP America, YCW 750 OGP.

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 broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Either factory- or field-fabricated system.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.
- 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 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.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less.
- E. Sealants used inside the weatherproofing system 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."
- F. Structural Glazing Sealants: ASTM C 1184, chemically 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 structural-sealant manufacturer for use in curtain-wall assembly indicated.
 1. Color: Black.

- G. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
 - 1. Color: Match structural sealant.

2.5 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 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.
 7. Components curved to indicated radii.
- D. Fabricate components to resist water penetration as follows:
1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.
- F. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
 2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
 3. Preparation includes, but is not limited to, cleaning and priming surfaces.
 4. Seal joints watertight unless otherwise indicated.
 5. Install glazing to comply with requirements in Section 088000 "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Exterior Storefront Systems: Color Anodic Finish, AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 1. Color: Bronze.

2.8 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 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. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal 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 primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
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.
- C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
1. Test a minimum of two areas on each building facade.
 2. Repair installation areas damaged by testing.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084416

SECTION 085113 SLIDING ALUMINUM FRAME WINDOWS (INTERIOR)

Part 1 - General

1.01 SUMMARY

Provide all labor, material, and equipment necessary to furnish and install aluminum windows as shown on drawings and specifications herein. Window shapes and accessories as specified and detailed shall establish the type of units and materials to be used to provide the functional performance and aesthetic requirements desired. Details indicate the required depth and profile.

1.02 RELATED REQUIREMENTS

Section 079200 – Joint Sealers

Section 088000 – Glass and Glazing

1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440-05 “Standard/Specification for Windows, Doors, and Unit Skylights”
- B. AAMA 502 "Voluntary Specification for Field Testing of Newly Installed Fenestration Products"
- C. AAMA 611 "Voluntary Specification for Anodized Architectural Aluminum"
- D. AAMA 701/702 "Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals”
- E. AAMA 1503 “Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections”
- F. AAMA 2603 “Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels”
- G. AAMA 2604 “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels”
- H. AAMA 2605 “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels”
- I. ASTM E 90 “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions”
- J. ASTM E 283 "Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen"
- K. ASTM E 330 "Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference"
- L. ASTM E413 “Classification for Rating Sound Insulation”

- M. ASTM E 547 "Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential"
- N. ASTM E966 "Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Facade Elements"
- O. ASTM E1332-10a "Standard Classification for Determination of Outdoor-Indoor Transmission Class"
- P. ASTM E1425 "Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems"
- Q. ASTM E 2190 "Standard Specification for Insulating Glass Unit Performance and Evaluation"
- R. ASTM F588 "Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact"
- S. NFRC 100 "Procedure for Determining Fenestration Product U-Factors"
- T. NFRC 200 "Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence"
- U. NFRC 500 "Procedure for Determining Fenestration Product Condensation Resistance Values"

1.04 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: As specified in Part 2 and with the following requirements.
- B. Uniform Load Structural Test
 - 1. With the primary sash in a closed position, and the secondary (exterior) set of sash in the full open position, test in accordance with ASTM-E-330. At a static air pressure difference of 60.0 pounds per square foot with pressure applied both positively and negatively.
 - 2. Static air pressure difference shall be 1.5 times the design pressure used in 1.03 A. (1.5 is the factor used to provide a margin of safety in aluminum windows and is the minimum recommended by the AAMA).
 - 3. At the conclusion of the test, there shall be no glass breakage; permanent damage to fasteners, hardware parts, support arms, or actuating mechanisms, nor any other damage which would cause the window to be inoperable. Permanent deformation of any frame, sash, or ventilator member shall not exceed 0.04% of its span.
- C. Sound Transmission
 - 1. Windows shall be fully assembled and glazed prior to testing. Acoustic performance based on glass performance alone or theoretical calculations will not be accepted.
 - 2. Testing shall be performed in an NVLAP Certified Test Laboratory.
 - 3. Sound Transmission Class (STC). Products shall be tested in accordance with ASTM E90-09 and perform to a minimum STC-44.

1.05 QUALITY ASSURANCE

- A. All testing shall be performed by an independent architectural testing laboratory accredited by the American Architectural Manufacturers Association (AAMA), the National Voluntary Laboratory Accreditation Program (NVLAP) and the International Conference of Building Officials (ICBO) and such other accreditation as may be required by state or local building regulations.
- B. The manufacturer shall provide the architect and owner a notarized affidavit of compliance certifying that the doors furnished for this project are identical in every aspect of design, component parts (including sealants and the application thereof, reinforcing members, etc.) and fabrication techniques as the doors tested in the laboratory for which test reports have been furnished.

1.06 SUBMITTALS

- A. Window manufacturer shall supply test reports from an AAMA- and NVLAP- accredited laboratory certifying compliance with performance specifications for each type of window supplied for this project.
- B. Window manufacturer shall supply product data for each type of window required, including:
 - 1. Construction details and fabrication methods.
 - 2. Data on hardware and accessories.
 - 3. Recommendations for maintenance and cleaning of exterior surfaces.
- C. Before proceeding with the manufacture of windows, the window contractor shall submit complete shop drawings with installation details for the Architect's approval. These drawings shall also show window elevations, details of all window sections, collateral materials, details of anchorage, associated hardware.
- D. Window manufacturer shall submit three [3] samples of finish.
- E. Window manufacturer shall submit a copy of the product warranty to be applied to this project.

1.07 WARRANTY

- A. The manufacturer shall warrant the product against material defects or defects in manufacturing. If a defect is discovered and brought to the attention of the Manufacturer, the defect will be corrected at no cost to the owner. Warranty shall not be pro-rated. Warranties requiring the owner to return windows to the factory for repair or replacement shall not be accepted.
 - 1. Windows: warrant for Ten [10] years against defects in material or workmanship under normal use.
 - 2. Insulating glass units: warrant seal for Ten [10] years against visual obstruction from film formation or moisture collection between internal glass surfaces, excluding that caused by glass breakage or abuse.
 - 3. Finish:
 - Organic finish conforming to AAMA 2605-05: warrant for Ten [10] years against chipping, peeling, cracking, chalking, or fading.

Part 2 Products

2.01 MANUFACTURER

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR 82-2001
PERMIT SUBMITTAL
APRIL 2024

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A. Basis of Design: St. Cloud Window, Inc., 390 Industrial Blvd., Sauk Rapids, MN 56379, Phone: 800-383-9311, Fax: 320-255-1513, www.stcloudwindow.com

1. SCW940 A7 – Horizontal Rolling.

B. Additional Manufacturers.

1. C R Laurence
2. Quick Serve

2.02 MATERIALS

A. Aluminum Extrusions

1. Shall be accurately extruded aluminum alloy 6063-T6.
2. All sash, screen, and frame members shall have a minimum wall thickness of 0.062.
3. Sill frame shall be constructed of extruded tubular shapes and shall include an aluminum closed weep system to prevent accumulation of water in sill. Tubular shapes that are formed by snapped-on or slide-together extrusions shall not be accepted.
4. Exterior and interior frame sill shall have a minimum slope of 5 degrees.

B. Thermal Barrier

1. All frame members shall be thermally broken by an extruded PVC thermal-barrier which shall provide complete metal-to-metal separation between the inner and outer frame members of not less than ¼". The thermal-barrier shall interlock to both halves of the frame, securely locking them together, though not inhibiting the expansion and contraction of either part. A bead of sealant shall be applied to the complete perimeter of the window to seal the joints between the frame and thermal-barrier. A poured and de-bridged thermal-barrier will not be accepted.

C. Gaskets

1. All corner joints of the master frame shall have neoprene gaskets to assure a weather-tight seal.

D. Weather-stripping

1. All sashes shall be double weather-stripped with 100% woven pile and Mylar center fins conforming to AAMA 701/702. Weatherstripping to be secured within extruded shapes of the aluminum profiles to prevent movement. Surface applied weather strip shall not be accepted.

E. Hardware

1. All interior sash rails shall have a spring-loaded extruded metal self-latching lock.

2. Sash Rollers: All horizontal rolling window sashes shall have a minimum of two sash rollers per sash made of Delrin material operating on a stainless steel axle. Rollers shall be recessed into the bottom sash rail so as not to protrude beyond the sash extrusion or weather-strip. Stainless steel rollers will not be accepted.
3. Balances: All sashes must be fully balanced with a minimum of two balances per sash. Balances are to be made of zinc die-cast metal with nylon rollers. Balances must provide a positive lifting force through the full range of sash travel and hold the sash stationary at any open position without the use of auxiliary frictional devices or holding pins. Overhead balances and/or exposed balance cables or cords will not be acceptable. Balances are to be housed inside of jamb sash rails and made removable with the use of take-out clips for ease of replacement without the use of special tools.

F. Glazing

1. All glazing shall comply with the performance requirements outlined in section 088000 – Glass and Glazing
2. Nominal glass thickness and type shall be:
 - a. Interior glass lite
 - i) Thickness: 1/4"
 - ii) Tint: clear
 - iii) Type: tempered
- 3.

2.03 FABRICATION

- A. Window shall consist of two separate frames permanently interlocked by a rigid vinyl thermal-barrier. All joints of the frame and sash shall be butt type, secured by means of thread-cutting type screws anchored into screw ports which shall be an integral part of frame members. All corner joints shall be joined neatly in a manner to provide a weather-tight connection. Sash corners to be internally sealed. All sharp milled edges and corners of sash and screen frame shall be de-burred and made smooth. The meeting rail shall be of tubular construction, double weather-stripped and interlocked when in a closed position. Window unit is to be constructed in a manner that will facilitate the replacement of worn or damaged parts, hardware, or weather-strip.

2.04 FINISH

A. Interior:

Polyvinylidene Fluoride PVDF Organic Coatings: Finish shall be 70% fluoropolymer (PVDF) organic coating in a color selected by Architect. Applied coatings shall meet or exceed AAMA 2605-05, including 10 years Florida exposure and 4000 hours humidity tests

Color to be selected by Architect from Manufacturer's full range of options.

Part 3 Erection

3.01 INSTALLATION

- A. All window and related window components shall be installed in accordance with requirements of the owner and the approved shop drawings of the Manufacturer. Installation shall be by a contractor who is experienced and who shall document at least one other projects of similar nature and scope for which the window products were successfully installed.
- B. All materials shall be erected plumb, level and true, relative to the building structure. The maximum variation from plumb and level shall not exceed 1/8" (plus or minus) over ten feet.
- C. Approved insulation materials shall be installed in the frame cavity on the interior portion of the window frame. Area adjacent to the exterior of the window frame shall remain uninsulated. The window installer shall use caution in the insulation operation to avoid overlapping insulation materials across the thermal-barrier connector thus bridging the two separate frame members.

3.02 CAULKING

- A. A grade "A" type urethane caulking compound: Pecora, Tremco, Vulkem, or equal as approved by the Architect, shall be applied per the installation drawings and details at all points where the aluminum master frame and/or panning intersects the masonry or other exterior wall finish. The caulking material shall be applied in a manner which assures a continuous air- and water-tight perimeter seal. Color to match the color of the aluminum windows unless specified otherwise by the Architect.

3.03 ADJUSTMENTS, PROTECTION, AND CLEANING

- A. After installation, the erector shall remove all sealants, caulking and other misplaced materials from all surfaces, including adjacent work. The window frame, sash, and glass shall be cleaned thoroughly with materials and methods recommended by the window and glass manufacturers and shall not cause any defacement of the work.
- B. Installer shall make any and all adjustments to window sash and hardware to cause the operating sash to function properly and in accordance with the manufactures standards.
- C. Protection of glass and window materials: Protect from contact with contaminating substances resulting from construction operations. After installation and cleaning of windows by window contractor, the general contractor shall be responsible for maintaining the cleanliness and protection of the window from damage from other trades.
- D. Remove all sealant, caulking and other misplaced materials from all surfaces, including adjacent work. The window frames, casing, and glass shall be thoroughly cleaned with materials and methods recommended by the window and glass manufacturer and shall not cause any defacement of the work.
- E. The general contractor shall be responsible for the protection of the work from damage by other trades.

END OF SECTION 085113

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.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access

control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

- a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
 2. Suppliers submission of their AHC staff employee certification shall be provided. The staff AHC shall be required to provide the suppliers submittal.
 3. Submit qualifications showing compliance with the Installer Qualifications required under 1.4/C.
 4. Submit qualifications showing compliance with the Supplier Qualifications required under 1.4/D.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. 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. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 5 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 20 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. 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.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing 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.
 6. Keying conference shall be handled directly between a Best representative and the Owner.
- 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), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures

- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.

- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Please note that ASSA ABLOY is transitioning the Yale Commercial brand to Arrow. This affects only the brand name; the products and product numbers will remain unchanged. The brand transition is expected to be complete in or about May of 2024, and products shipping after that time will be branded Arrow.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

- a. Widths up to 3'6": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'7" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
- a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
- a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Manufacturers:
- a. Ives (IV) - 5BB Series, 5 knuckle.
 - b. McKinney (MK) - TA/T4A Series, 5 knuckle.
 - c. dormakaba Best (ST) - F/FBB Series, 5 knuckle.
 - d. No Substitution, Match Specified Basis of Design.

2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Manufacturers:.
- a. Ives (IV).
 - b. Pemko (PE).
 - c. Dormakaba Best (ST).
 - d. No Substitution, Match Specified Basis of Design.

2.4 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets.
1. Manufacturers:

- a. Pemko (PE) - EL-CEPT Series.
- b. Securitron (SU) – CEPT-10 Series.
- c. Von Duprin (VD) - EPT-10 Series.
- d. No Substitution, Match Specified Basis of Design.

2.5 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
 - 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 - 2. Furnish dust proof strikes for bottom bolts.
 - 3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 - 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - 5. Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood (RO).
 - c. Trimco (TC).
 - d. No Substitution, Match Specified Basis of Design.

- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 - 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 - 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 - 4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 - 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - 6. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).
 - d. No Substitution, Match Specified Basis of Design.

2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
1. Manufacturers:
 - a. dormakaba Best (BE).
 - b. Match Existing, Field Verify.
 - c. No Substitution, Match Specified Basis of Design.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Standard.Match Facility Keyway.
- C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
 2. Manufacturers:
 - a. dormakaba Best (BE) - CORMAX.
 - b. No Substitution, Match Specified Basis of Design.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. Existing System: Field verify and key cylinders to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (3).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
 - d. No Substitution, Match Specified Basis of Design.

2.8 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all features and functionality as specified herein.

1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. dormakaba Best (BE) – 40H Series.
 - c. Sargent Manufacturing (SA) - 8200 Series.
 - d. No Substitution, Match Specified Basis of Design.

2.9 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - CLX3300 Series.
 - b. dormakaba Best (BE) - 9K Series.
 - c. Sargent Manufacturing (SA) - 10X Line.
 - d. No Substitution, Match Specified Basis of Design.

2.10 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.11 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. Exit devices shall have a five-year warranty.
 - 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. All exterior doors shall be provided with both top and bottom rods. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 5" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.
 - c. dormakaba Best (PR) - Apex 2000 Series.
 - d. No Substitution, Match Specified Basis of Design.

2.12 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..
1. Manufacturers:
 - a. dormakaba (DO) - HD8000 Series.
 - b. Norton Rixson (NO) - 7500 Series.
 - c. Sargent Manufacturing (SA) - 351 Series.
 - d. No Substitution, Match Specified Basis of Design.

2.13 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.
- B. Provide the specified extensions where shown.
1. Manufacturers:
 - a. LCN Door Closers (LC) - SEM7800 Series.
 - b. Norton Rixson (RF) - 980/990 Series.
 - c. Sargent Manufacturing (SA) - 1560 Series.
 - d. No Substitution, Match Specified Basis of Design.

2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Architectural Builders Hardware (AH).
 - b. dormakaba (DO).
 - c. Norton Rixson (RF).
 - d. No Substitution.

2.15 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Hiawatha, Inc. (HI).
 - b. Rockwood (RO).
 - c. Trimco (TC).

2.16 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko (PE).
 - 3. Reese Enterprises, Inc. (RE).
 - 4. No Substitution, Match Specified Basis of Design.

2.17 ELECTRONIC ACCESSORIES

- A. Linear 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 plus 50% for the specified electrified hardware and access control equipment.
 - 1. 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.
 - 2. Manufacturers:

- a. Alarm Controls (AK) - APS Series.
 - b. dormakaba Best (BE) - RPSMLR Series.
 - c. Securitron (SU) - AQL Series.
 - d. No Substitution, Match Specified Basis of Design.
- B. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.
- 1. 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.
 - 2. Manufacturers:
 - a. Securitron (SU) - AQD Series.
 - b. Altronix (AS) - Maximal 3.
 - c. No Substitution, Match Specified Basis of Design.

2.18 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.

2.19 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.
- D. Antimicrobial Finishes: Where specified, finishes on locksets, latchsets, exit devices and push/pull trim to incorporate an FDA recognized. Silver Ion, antimicrobial coating 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. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should

be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. ST - BEST Hinges
2. SU - Securitron
3. RO - Rockwood
4. BE - BEST Locks & Closers
5. PR - BEST Precision
6. AH - Architectural Builders Hardware
7. RF - Rixson
8. PE - Pemko
9. SA - SARGENT

Hardware Sets

Set: HW-01

Doors: 100A, 100B, 100C
Each Door to Receive

2 Continuous Hinge	669HDUL EPT 120"	BK	ST
2 Electric Power Transfer	CEPT-10	630	SU
1 Concealed Vert Rod Exit	MLR TS 2603 10' No Trim AM AM	622	PR
1 Concealed Vert Rod Exit	MLR TS 2601 10' No Trim AM AM	622	PR
1 Rim Cylinder	12E-72 S2 RP Patented	622	BE
2 Pull	RM3840-84 Mtg-Type 12XHD	BSP	RO
2 Surface Closer	HD8016 SDS PC SNDTPK	693	BE
2 Drop Plate	DP80	693	BE
2 Angle Bracket	NFHD	693	BE
2 Spacer	BS	693	BE
1 Threshold	2005BSPV x 72" MSES25SS	BSP	PE

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2 Switch	3287	SA
1 Power Supply	RPSMLR2	PR

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE ACTIVE LEAF IS PROVIDED WITH MELR, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE EXIT DEVICE. THE INACTIVE LEAF IS EXIT ONLY AND IS ALSO MONITORED FOR REX AND DPS.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

BALANCE OF HARDWARE TO BE PROVIDED BY THE DOOR SUPPLIER.

Set: HW-02

Doors: 112, 127, 128
Each Door to Receive

3 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Mortise Lock	45H0L 15H AM VIB	626	BE
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Door Stop	441	US26D	RO
1 Gasketing	S773BL 20'	US32D	PE

Notes: PROVIDE FOUR HINGES FOR DOOR 112.

Set: HW-03

Doors: 110, 111, 210, 211
Each Door to Receive

3 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Arm Pull	AP1007	US32D-MS	RO
1 Push Plate	73RCC	US32D-MS	RO
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Wall Stop	409	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE

Notes: PROVIDE FOUR HINGES FOR DOORS 110/111.

Set: HW-04

Doors: 113, 131, 209, 300
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37D 15D S3 AM Patented	626	BE
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Door Stop	441	US26D	RO
1 Gasketing	S773BL 20'	US26D	PE

Notes: CLOSER PROVIDED TRI PACKED. MOUNTING SIDE SHALL KEEP THE CLOSER FROM CORRIDOR VISIBILITY PUSH OR PULL SIDE MOUNT AS REQUIRED TO MEET THIS REQUIREMENT.

Notes: PROVIDE FOUR HINGES FOR DOOR 113.

Set: HW-05

Doors: 119, 124B, 126, 129, 130A
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37R 15D S3 AM Patented	626	BE
1 Surf Overhead Stop	4424	US32D	AH
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	630	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE

Notes: MOUNT DOOR CLOSERS ON THE PULL SIDE OF THE DOOR AND THE OH STOP ON THE PUSH.

Set: HW-06

Doors: 108B, 116B, 130B
Each Door to Receive

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3 Hinge, Full Mortise	FBB191NRP 4-1/2" x 4-1/2"	US32D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Rim Exit Device	MLR TS 2108 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	303AS x 36" x 84" TKSP	US32D	PE
1 Sweep	315CN x 36" TKSP	US32D	PE
1 Threshold	2715A x 36" MSES10SS	US32D	PE
1 Switch	3287	630	SA
1 Power Supply	RPSMLR2		PR

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE ACTIVE LEAF IS PROVIDED WITH MELR, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE EXIT DEVICE. THE INACTIVE LEAF IS EXIT ONLY AND IS ALSO MONITORED FOR REX AND DPS.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-07

Doors: 114
Each Door to Receive

4 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37AB 15D S3 AM Patented	626	BE
1 Wall Stop	409	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE

Set: HW-08

Doors: 117
Each Door to Receive

3 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37AB 15D S3 AM Patented	626	BE
1 Wall Stop	409	US32D	RO
1 Gasketing	S773BL 17'	US32D	PE

1 Gasketing	ACP112BL/2	630	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE

Set: HW-09

Doors: 133
Each Door to Receive

3 Hinge, Full Mortise	FBB191NRP 4-1/2" x 4-1/2"	US32D	ST
1 Mortise Lock	45H7TD 15H AM Patented	626	BE
1 Surf Overhead Stop	4424	US32D	AH
1 Gasketing	303AS x 36" x 84" TKSP	US32D	PE
1 Sweep	315CN x 36" TKSP	US32D	PE
1 Threshold	2715A x 36" MSES10SS	US32D	PE

Set: HW-10

Doors: 122, 123
Each Door to Receive

6 Hinge, Full Mortise	FBB179NRP 5" x 4-1/2"	US26D	ST
2 Flush Bolt	555	US26D	RO
1 Cylindrical Lock	9K37D 15D S3 AM Patented	626	BE
2 Surf Overhead Friction Stay	4434	US32D	AH
1 Astragal	351C/CPK 84" TKSP	US32D	PE
1 Gasketing	S773BL 25'	US32D	PE
1 Gasketing	ACP112BL/2	630	PE
2 Door Bottom	411APKL 48"	US32D	PE
1 Threshold	151A x 96" MSES10SS	US32D	PE

Set: HW-11

Doors: 132
Each Door to Receive

8 Hinge, Full Mortise	FBB199NRP 5" x 4-1/2"	US32D	ST
2 Flush Bolt	555	US26D	RO
1 Mortise Lock	45H7TD 15H AM Patented	626	BE
2 Surf Overhead Stop	4424	US32D	AH
1 Astragal	29324CNB x 96" TKSP	US32D	PE

1 Gasketing	S773BL 25'	US32D	PE
2 Sweep	315CN x 48" TKSP	US32D	PE
1 Threshold	2715BSP x 96" MSES25SS	US32D	PE

Set: HW-12

Doors: 106
Each Door to Receive

4 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37D 15D S3 AM Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	630	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE

Set: HW-13

Doors: 108A, 208A, 301
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Rim Exit Device	FL 2108 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 17'	US32D	PE

Set: HW-14

Doors: 118
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Electrified Cylindrical Lock	9KW37DEU 15D S3 AM Patented RQE	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 17'	US32D	PE

1 Switch	3287	SA
1 Power Supply	AQL4-B100R8E1	SU

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE DOOR IS PROVIDED WITH SOLENOID, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE LOCK AND DOOR.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

THE B100 MODULE WILL PROVIDE 12VDC POWER FOR EDGE MOUNTED WALL READERS IF REQUIRED.

Set: HW-15

Doors: 212
Each Door to Receive

3 Hinge, Full Mortise	FBB191NRP 4-1/2" x 4-1/2"	US32D	ST
1 Cylindrical Lock	9K37W 15D S3 AM Patented	626	BE
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	303AS x 36" x 84" TKSP	US32D	PE
1 Sweep	315CN x 36" TKSP	US32D	PE
1 Threshold	2715A x 36" MSES10SS	US32D	PE

Notes: DUE TO POTENTIAL ROOF ACCESS, ASYLUM FUNCTION (LOCKED BOTH SIDES AT ALL TIMES) IS PROVIDED. USE OF A KEY WILL BE REQUIRED TO GAIN ACCESS FROM THE ROOF SIDE MECHANICAL AND TO RE-ENTER FROM THE MECHANICAL SIDE TO THE INTERIOR OF THE BUILDING.

Set: HW-16

Doors: 214
Each Door to Receive

8 Hinge, Full Mortise, Hvy Wt	FBB199NRP 5" x 4-1/2"	US32D	ST
2 Flush Bolt	556WS	US26D	RO
1 Cylindrical Lock	9K37D 15D S3 AM Patented	626	BE
2 Surf Overhead Friction Stay	4434	US32D	AH
1 Astragal	357C 96" TKSP	US32D	PE
1 Gasketing	S773BL 25'	US32D	PE

2 Sweep	315CN x 48" TKSP	US32D	PE
1 Threshold	2715A x 96" MSES10SS	US32D	PE

Notes: MOUNT ASTRAGAL TO PULL SIDE OF ACTIVE LEAF. NOTCH FOR THE STRIKE LIP AS REQUIRED.

Set: HW-17

Doors: 101B, 105B
Each Door to Receive

8 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
2 Push Plate	73RCC	US32D-MS	RO
2 Pull	RM3840-24 Mtg-Type 12XHD	US32D	RO
2 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
2 Kick Plate	K1050 8" x 34"	US32D	RO
1 Astragal	351C/CPK 96" TKSP	US32D	PE
1 Gasketing	S773BL 25'	US32D	PE
1 Gasketing	ACP112BL/2	630	PE
2 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 72" MSES10SS	US32D	PE

Set: HW-18

Doors: 101A, 105A
Each Door to Receive

8 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
2 Electric Power Transfer	CEPT-10	630	SU
1 Surface Vert Rod Exit	FL MLR 2208 LBR 4908A AM AM	630	PR
1 Surface Vert Rod Exit	FL MLR 2201 LBR No Trim AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
2 Surface Closer	HD8016 SPA PC SNDTPK	689	BE
2 Kick Plate	K1050 8" x 34"	US32D	RO
2 Electromagnetic Holder	998M 24VDC	689	RF
2 Armature	900	689	RF
2 Spacer	900-600	689	RF
1 Astragal	351C/CPK 96" TKSP	US32D	PE
1 Gasketing	ACP112BL/2	630	PE

2 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 72" MSES10SS	US32D	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE RETRACTED DURING AUDITORIUM USE. NO REX OR DPS MONITORING FOR THIS APPLICATION.

MHO'S SHALL BE ENGAGED DURING ENTERING FOR EVENT, THE END OF THE EVENT, AND INTERMISSIONS. THESE DEVICES ALSO NEED TO BE TIED INTO THE BUILDINGS FIRE ALARM SYSTEM AND WILL DISENGAGE IN THE EVENT OF ALARM. THESE DEVICES ARE 24VDC. DOORS MUST SWING 180 DEGREES.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-19

Doors: 102B
Each Door to Receive

8 Hinge, Full Mortise	FBB168NRP 5" x 4-1/2"	US26D	ST
2 Electric Power Transfer	CEPT-10	630	SU
1 Surface Vert Rod Exit	FL MLR 2208 LBR 4908A AM AM	630	PR
1 Surface Vert Rod Exit	FL MLR 2201 LBR No Trim AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
2 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
2 Kick Plate	K1050 8" x 46"	US32D	RO
1 Astragal	351C/CPK 108"	US32D	PE
1 Gasketing	ACP112BL/2	630	PE
1 Gasketing	S773BL 30'		PE
2 Door Bottom	411APKL 48"	US32D	PE
1 Threshold	151A x 96" MSES10SS	US32D	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE RETRACTED DURING AUDITORIUM USE. NO REX OR DPS MONITORING REQUIRED FOR THIS APPLICATION.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-20

Doors: 102A

Each Door to Receive

4 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Rim Exit Device	FL MLR 2108 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE RETRACTED DURING AUDITORIUM USE FOR SOUND MITIGATION. NO REX OR DPS MONITORING FOR THIS APPLICATION.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-21

Doors: 102D, 116A

Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Rim Exit Device	2108 CD 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Mortise Cylinder	1E-74 C4 RP2 Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE

1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE

Notes: THIS DOOR CAN BE MANUALLY DOGGED DURING EVENTS TO REDUCE THE SOUND OF THE OF THE EXIT DEVICE BEING ACTUATED. PROVIDE WITH CYLINDER DOGGING FOR AUTHORIZED USE. PROVIDE FOUR HINGES FOR DOOR 102D.

Set: HW-22

Doors: 115
Each Door to Receive

8 Hinge, Full Mortise, Hvy Wt	FBB168NRP 5" x 4-1/2"	US26D	ST
1 Surface Vert Rod Exit	2208 CD 4908A AM AM	630	PR
1 Surface Vert Rod Exit	2202 CD 4902A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	622	BE
2 Mortise Cylinder	1E-74 C4 RP2 Patented	626	BE
2 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
2 Kick Plate	K1050 8" x 46"	US32D	RO
1 Astragal	351C/CPK 96" TKSP	US32D	PE
1 Gasketing	S773BL 25'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE
2 Door Bottom	411APKL 48"	US32D	PE
1 Threshold	2005AV x 96" MSES10SS	US32D	PE

Set: HW-23

Doors: 203A, 203B, 203C
Each Door to Receive

4 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Push Plate	73RCC	US32D- MS	RO
1 Pull	RM3840-24 Mtg-Type 12XHD	US32D	RO
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE

Set: HW-24

Doors: 202, 204, 207
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Rim Exit Device	FL MLR 2108 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Electromagnetic Holder	998M 24VDC	689	RF
1 Armature	900	689	RF
1 Spacer	900-600	689	RF
1 Gasketing	S773BL 20'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE RETRACTED DURING AUDITORIUM USE. NO REX OR DPS MONITORING FOR THIS APPLICATION.

MHO'S SHALL BE ENGAGED DURING ENTERING FOR EVENT, THE END OF THE EVENT, AND INTERMISSIONS. THESE DEVICES ALSO NEED TO BE TIED INTO THE BUILDINGS FIRE ALARM SYSTEM AND WILL DISENGAGE IN THE EVENT OF ALARM. THESE DEVICES ARE 24VDC. DOORS MUST SWING 180 DEGREES.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-25

Doors: 305
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Electrified Cylindrical Lock	9KW37DEU 15D S3 AM Patented RQE	626	BE

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1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 17'	US32D	PE
1 Gasketing	ACP112BL/2		PE
1 Door Bottom	411APKL 36"		PE
1 Threshold	151A x 36" MSES10SS		PE
1 Switch	3287		SA
1 Power Supply	AQL4-B100R8E1		SU

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE DOOR IS PROVIDED WITH SOLENOID, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE LOCK AND DOOR.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

THE B100 MODULE WILL PROVIDE 12VDC POWER FOR EDGE MOUNTED WALL READERS IF REQUIRED.

Set: HW-26

Doors: 306
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37R 15D S3 AM Patented	626	BE
1 Surf Overhead Stop	4424	US32D	AH
1 Gasketing	S773BL 17'	US32D	PE
1 Sweep	315CN x 36" TKSP	US32D	PE

Set: HW-27

Doors: 307
Each Door to Receive

3 Hinge, Full Mortise	FBB179 4-1/2" x 4-1/2"	US26D	ST
1 Cylindrical Lock	9K37R 15D S3 AM Patented	626	BE
1 Surf Overhead Stop	4424	US32D	AH
1 Gasketing	S773BL 17'	US32D	PE
1 Sweep	315CN x 36" TKSP	US32D	PE

Set: HW-28

Doors: 121A
Each Door to Receive

6 Hinge, Full Mortise, Hvy Wt	FBB168NRP 5" x 4-1/2"	US26D	ST
2 Push Plate	73RCC	US32D-MS	RO
2 Pull	RM3840-24 Mtg-Type 12XHD	US32D	RO
2 Surface Closer	HD8016 DST PC SNDTPK	689	BE
2 Wall Stop	409	US32D	RO
1 Astragal	351C/CPK 84" TKSP	689	PE
1 Gasketing	S773BL 25'	689	PE
2 Gasketing	ACP112BL/2	689	PE
2 Door Bottom	411APKL 48"	689	PE
1 Threshold	151A x 96" MSES10SS	689	PE

Notes: MECHANICAL HOLD OPEN INTEGRATED TO THE DOOR CLOSER.

Set: HW-29

Doors: 121B
Each Door to Receive

6 Hinge, Full Mortise, Hvy Wt	FBB168NRP 5" x 4-1/2"	US26D	ST
2 Electric Power Transfer	CEPT-10	630	SU
1 Surface Vert Rod Exit	MLR TS 2203 4903A AM AM	630	PR
1 Surface Vert Rod Exit	TDS 2201 No Trim AM	630	PR
2 Surface Closer	HD8016 SPA PC SNDTPK	689	BE
1 Astragal	351C/CPK 84" TKSP	689	PE
1 Gasketing	S773BL 25'	689	PE
2 Gasketing	ACP112BL/2	689	PE
2 Door Bottom	411APKL 48"	689	PE
1 Threshold	2005AV x 96" MSES10SS	689	PE
2 Switch	3287	630	SA
1 Power Supply	RPSMLR2		PR

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE ACTIVE LEAF IS PROVIDED WITH MELR, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE EXIT DEVICE. THE INACTIVE LEAF IS EXIT ONLY AND IS ALSO MONITORED FOR REX AND DPS.

OPENING IS PROVIDED WITH MECHANICAL KEY OVERRIDE IN THE EVENT OF POWER FAILURE.

Set: HW-30

Doors: 120
Each Door to Receive

6 Hinge, Full Mortise, Hvy Wt	FBB168NRP 5" x 4-1/2"	US26D	ST
2 Flush Bolt	555	US26D	RO
1 Electrified Cylindrical Lock	9KW37DEU 15D S3 AM Patented RQE	626	BE
2 Surface Closer	HD8016 DST PC SNDTPK	689	BE
1 Astragal	351C/CPK 84" TKSP	US26D	PE
1 Gasketing	S773BL 25'	US26D	PE
1 Gasketing	ACP112BL/2	US26D	PE
2 Door Bottom	411APKL 48"	US26D	PE
1 Threshold	151A x 96" MSES10SS	US26D	PE
2 Switch	3287	689	SA
1 Power Supply	AQL4-B100R8E1		SU

Notes: THIS DOOR IS CONTROLLED WITH A CARD READER PROVIDED BY THE SECURITY INTEGRATOR. THE DOOR IS PROVIDED WITH SOLENOID, ALONG WITH REX AND DPS STATUS MONITORING INTEGRATED INTO THE LOCK AND DOOR. INACTIVE LEAF IS MONITORED FOR POSITION ONLY. MECHANICAL HOLD OPEN IS PROVIDED INTEGRATED INTO THE DOOR CLOSERS TO AID IN THE REMOVAL AND STORAGE OF THE PIANO.

THE B100 MODULE WILL PROVIDE 12VDC POWER FOR EDGE MOUNTED WALL READERS IF REQUIRED.

Set: HW-31

Doors: 124A
Each Door to Receive

6 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
2 Electric Power Transfer	CEPT-10	630	SU
1 Surface Vert Rod Exit	FL MLR 2208 LBR 4908A AM AM	630	PR
1 Surface Vert Rod Exit	FL MLR 2201 LBR No Trim AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
2 Surface Closer	HD8016 SDS PC SNDTPK	689	BE

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2 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 25'	US32D	PE
2 Gasketing	ACP112BL/2	US32D	PE
2 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	2005AV x 72" MSES10SS	630	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE RETRACTED DURING AUDITORIUM USE. NO REX OR DPS MONITORING FOR THIS APPLICATION.

Set: HW-32

Doors: 102C
Each Door to Receive

8 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Surface Vert Rod Exit	2208 CD 4908A AM AM	630	PR
1 Surface Vert Rod Exit	2202 CD 4902A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	622	BE
2 Mortise Cylinder	1E-74 C4 RP2 Patented	626	BE
2 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
2 Kick Plate	K1050 8" x 34"	US32D	RO
1 Astragal	351C/CPK 96" TKSP	689	PE
1 Gasketing	S773BL 25'	689	PE
1 Gasketing	ACP112BL/2	689	PE
2 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	2005AV x 72" MSES10SS	689	PE

Set: HW-33

Doors: 304
Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Electrified Cylindrical Lock	9KW37DEU 15D S3 AM Patented RQE	626	BE
1 Surface Closer	HD8016 AF80P PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO

1 Door Stop	441	US26D	RO
1 Gasketing	S773BL 17'	US32D	PE
1 Switch	3287		SA
1 Power Supply	AQL4-B100R8E1		SU

Notes: DOOR CLOSER SHALL BE PULL SIDE MOUNTED.

Set: HW-34

Doors: 303

Each Door to Receive

3 Hinge, Full Mortise	FBB191NRP 4-1/2" x 4-1/2"	US19	ST
1 Mortise Lock	45H7W 15H Patented	622	BE
1 Surf Overhead Hold Open	4414	S4	AH
1 Gasketing	303BSPS x 36" x 84" TKSP	US19	PE
1 Threshold	2005BSPV x 36" MSES10SS	US19	PE

Notes: LOCKSET IT STOREROOM FUNCTION, ALWAYS LOCKED FROM BOTH SIDES. MUST HAVE A KEY TO OBTAIN ACCESS FROM EITHER SIDE AS DOOR ACCESSES THE ROOF.

Set: HW-35

Doors: 208B

Each Door to Receive

3 Hinge, Full Mortise	FBB179NRP 4-1/2" x 4-1/2"	US26D	ST
1 Electric Power Transfer	CEPT-10	630	SU
1 Rim Exit Device	FL MLR 2108 4908A AM AM	630	PR
1 Rim Cylinder	12E-72 S2 RP Patented	626	BE
1 Surface Closer	HD8016 SDS PC SNDTPK	689	BE
1 Kick Plate	K1050 8" x 34"	US32D	RO
1 Gasketing	S773BL 17'	US32D	PE
1 Gasketing	ACP112BL/2	US32D	PE
1 Door Bottom	411APKL 36"	US32D	PE
1 Threshold	151A x 36" MSES10SS	US32D	PE
1 Power Supply	RPSMLR2		PR

Notes: APPLICATION REQUIRES OPENING BE TIED TO THE BUILDINGS FIRE ALARM SYSTEM. DOORS SHALL LATCH WHEN FIRE ALARM IS ENGAGED. LATCHES SHALL BE

RETRACTED DURING AUDITORIUM USE. NO REX OR DPS MONITORING FOR THIS APPLICATION.

END OF SECTION 087100

SECTION 088000-R1 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
 - 4. Curtain Wall

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, as defined in referenced glazing publications.
- A. Glass Fabricators: Firms that produce fabricated glass products. Fabrication processes include cutting, heat processing, insulating, spandrel, laminating and other fabrication activities as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.

Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA GDSG-1-1987: Glass Design for Sloped Glazing
 - 2. AAMA TIR-A7-1983 Sloped Glazing Guidelines
- B. American National Standards Institute (ANSI): ANSI Z 97.1 - Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test
- C. ASTM International (ASTM)
 - 1. ASTM C 1036 - Standard Specification for Flat Glass.
 - 2. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass
 - 3. ASTM C1172: Standard Specification for Laminated Architectural Flat Glass
 - 4. ASTM C 1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass.
 - 5. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- D. Consumer Product Safety Commission (CPSC): 16CFR-1201 - Safety Standard for Architectural Glazing Materials.
- E. Duplicate to above Underwriters Laboratory (UL)
 - 1. UL 263: Standard for Fire Tests of Building Construction and Material
 - 2. UL 9: Standard for Fire test of Window Assemblies
 - 3. UL 10B: Standard for Fire Tests of Door Assemblies
 - 4. UL 10C: Standard for Positive Pressure Fire Tests of Door Assemblies
- F. National Fire Protection Association (NFPA)
 - 1. NFPA 80: Standard for Fire Doors and Other Opening Protectives
 - 2. NFPA 257: Standard on Fire Test for Window and Glass Block Assemblies
 - 3. NFPA 252: Standard Methods of Fire Test of Door Assemblies

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass

lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated on drawings.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0.
 - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch- wide interspace.
3. Center-of-Glass Values: Based on using LBNL WINDOW 7.4 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.

1. Each color of tinted float glass.
 2. Fire-resistive glazing products.
 3. Insulating glass for each designation indicated.
 4. For each color (except black) of exposed glazing sealant indicated.
 5. Spandrel glass.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Qualification Data: For installers.
- G. Product Test Reports: For each of the following types of glazing products:
1. Tinted float glass.
 2. Coated float glass.
 3. Insulating glass.
 4. Glazing sealants.
 5. Glazing gaskets.
- H. Warranties: Special warranties specified in this Section.
- I. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants. Data based on previous testing of current sealant products, and glazing materials matching those specified is acceptable

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, tinted float glass, coated float glass, and insulating glass.

- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- E. Glazing for Fire-Rated Window Assemblies: Glazing for assemblies that comply with NFPA 80 and 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 257.
- F. Safety Glazing Products: Comply with testing requirements in CPSC 16 CFR 1201 and, ANSI Z97.1.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Glazing Manual."
 - 2. GANA Publications: GANA's "Sealant Manual"
 - 3. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. 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: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. AGC Glass North America (Basis of Design)
 - 2. Pilkington North America
 - 3. Vitro Architectural Glass
 - 4.

- B. Acceptable Fabricators
 - 1. American Insulated Glass
 - 2. OldCastle Building Envelope
 - 3. Trulite Glass and Aluminum Solutions
 - 4. Viracon

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
 - 1. Clear Float Glass: Class I (clear); with a minimum 88 percent visible light transmission and a minimum solar heat gain coefficient of 0.84 ..
 - 2. Tinted Float Glass: Type 1, Class II (tinted) , Bronze, with a minimum 54 percent visible light transmission and a minimum solar heat gain coefficient of .63.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 - 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 - 3. For uncoated glass, comply with requirements for Condition A.
 - 4. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where indicated.
- C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace and complying with ASTM E 2190 units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
 - 1. Provide Kind FT (fully tempered) glass lites.
 - 2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 - 3. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Primary Seal: Polyisobutylene
 - b. Secondary Seal: Two-part Silicone
 - a. Spacer Specifications: Bent, welded, or fused aluminum box spacer of color indicated .Mill Finish or Clear Anodized
 - 5. Desiccant: Molecular Sieve or silica gel, or blend of both.

2.3 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.
- B. Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials, and passes the hose stream test.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus.
 - b. Schott North America, Inc.; Laminated Pyran Crystal.
 - c. Vetrotech Saint-Gobain; SGG Keralite FR-L.

2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene, ASTM C 864.
 - 2. EPDM, ASTM C 864.
 - 3. Silicone, ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber, ASTM C 1115.
 - 5. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene.
 - 2. EPDM.
 - 3. Silicone.
 - 4. Thermoplastic polyolefin rubber.
 - 5. Any material indicated above.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Neutral-Curing Silicone Glazing Sealants:
 - a. Products:
 - 1) Dow Corning Corporation; 791.
 - 2) Dow Corning Corporation; 795.
 - 3) GE Silicones; SilPruf NB SCS9000.
 - 4) GE Silicones; UltraPruf II SCS2900.
 - 5) Pecora Corporation; 865.
 - 6) Pecora Corporation; 895.
 - 7) Pecora Corporation; 898.
 - b. Type and Grade: S (single component) and NS (nonsag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (nontraffic).
 - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.
- C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. 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; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

2.9 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units: Class 1 (clear) Kind FT (fully tempered) float glass.
 - 1. Thickness: Minimum 6.0 mm.
- B. Uncoated Tinted Float-Glass Units: Class 2 (tinted) Kind FT (fully tempered) float glass.
 - 1. Thickness: Minimum 6.0 mm.
 - 2. Tint Color: Match Architect sample.

2.10 FIRE-PROTECTION-RATED GLAZING TYPES

- A. Glass Type: 20-minute, 45-minute, 60-minute, 90-minute, and 120-minute fire-rated glazing with hose stream test; laminated ceramic glazing.
 - 1. Provide safety glazing labeling.

2.11 INSULATING-GLASS UNITS

- A. LOW-E, Tinted Laminated Insulating-Glass Units:
 - 1. Basis of Design: AGC Glass Energy Select 25 Bronze.
 - 2. Overall Unit Thickness: Minimum 1-5/16 inch nominal
 - 3. Interspace Content: Air.
 - 4. Outdoor Lite: Class 2 (tinted) float glass, coated
 - a. Tint Color: Bronze
 - b. Thickness: 6mm
 - c. Kind FT (fully tempered).
 - d. Low-E Coating: Surface 2
 - 5. Indoor Lite: Clear laminated float glass.
 - a. Nominal Thickness: 14mm Individual Lite Thickness: 6mm minimum
 - b. Kind HS heat strengthened
 - c. Interlayer: .090" Clear polyvinyl butyral (pvb)
 - 6. Performance:
 - a. Visible Light Transmittance: 39% minimum
 - b. Exterior Reflectance: 7% maximum
 - c. SHGC: .26 maximum
 - d. Winter U-Value: .28 maximum
 - e. Summer U-Value: .26 maximum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
 - H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
 - I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
 - J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 - K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- 3.5 GASKET GLAZING (DRY)
- A. Fabricate compression gaskets in 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. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 - D. Install gaskets so they protrude past face of glazing stops.
- 3.7 LOCK-STRIP GASKET GLAZING
- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.
- 3.8 CLEANING AND PROTECTION
- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fixed, extruded-aluminum louvers.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.
 - 2. Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors and frames.
 - 3. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

- C. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.
 - 1. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code--Aluminum."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- D. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Louvers:
 - a. Airline Products Co.
 - b. Airolite Company (The).
 - c. American Warming and Ventilating, Inc.
 - d. Arrow United Industries.
 - e. Carnes Company, Inc.
 - f. Cesco Products.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers, Inc.
 - l. Metal Form Manufacturing Company, Inc.
 - m. NCA Manufacturing, Inc.
 - n. Nystrom Building Products.
 - o. Reliable Products; Hart & Cooley, Inc.
 - p. Ruskin Company; Tomkins PLC.
 - q. Vent Products Company, Inc.
- B. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

- B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, alloy 319.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- E. Fasteners: Of 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.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
 - 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
- C. Maintain equal louver blade spacing to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel, unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Where indicated, provide subsills made of same material as louvers or extended sills for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- H. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view, unless otherwise

indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Louver Depth: Coordinate with wall thickness, minimum 6”.
2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch for blades and 0.080 inch for frames.
3. Mullion Type: Exposed.
4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.7 ALUMINUM FINISHES

A. High-Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating;

Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - a. Color and Gloss: Bronze, Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. 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.
- 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. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092530 - GYPSUM SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Glass-mat gypsum sheathing board.
- B. Related Sections include the following:
 - 1. Division 7 Section "Sheet Metal Flashing and Trim for flashing installed with gypsum sheathing.
 - 2. Division 9 Section "Gypsum Board Assemblies" for steel framing and interior gypsum panels incorporated into assemblies with gypsum sheathing on the exterior.
 - 3. Division 7 Section "Synthetic Fluid Applied Membrane Air Barrier"

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Glass-Mat Gypsum Sheathing Board.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1.7 COORDINATION

- A. Glass-Mat Gypsum Sheathing Board:
 - 1. Do not leave exposed to weather for more than 180 days.

PART 2 - PRODUCTS

2.1 GYPSUM SHEATHING

- A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.
 - 1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corporation.
 - 2. Type and Thickness: Type X, 5/8 inch.
 - 3. Size: 48 by 96 inches for vertical installation.

2.2 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Glass-Mat Gypsum Sheathing Board:
 - 1. Silicone Emulsion Sealant: ASTM C 834, compatible with sheathing tape and sheathing, recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 2. Glass-Fiber Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.3 ACCESSORY MATERIALS

- A. Fasteners: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 1. For steel framing less than 0.0329 inch thick, attach sheathing with steel drill screws complying with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing with drill screws complying with ASTM C 954.

PART 3 - EXECUTION

3.1 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and manufacturer's written instructions.
- B. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
 - 1. Install boards with a 3/8-inch setback where non-load-bearing construction abuts structural elements.
 - 2. Install boards with a 1/4-inch setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- F. Vertical Installation: Install board vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

3.2 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written recommendations.
 - 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 092530

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Exterior gypsum board panels for ceilings and soffits.
 - 3. Tile backing units.
 - 4. Non-load-bearing steel framing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold-Formed Metal Framing for load-bearing steel framing.
 - 2. Division 7 Section "Building Insulation for insulation and vapor retarders installed in gypsum board assemblies.
 - 3. Division 9 Section "Ceramic Tile".
 - 4. Division 9 Sections, "Interior Painting" and "Exterior Painting".

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size sample in 12-inch- long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products." UL's "Fire Resistance Directory."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Consolidated Systems, Inc.
 - c. Dale Industries, Inc. - Dale/Incor.
 - d. Dietrich Industries, Inc.
 - e. MarinoWare; Division of Ware Ind.
 - f. National Gypsum Company.
 - g. Scafco Corporation.
 - h. Unimast, Inc.

- i. Western Metal Lath & Steel Framing Systems.
2. Gypsum Board and Related Products:
- a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- C. Hangers: As follows:
- 1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 - 2. Rod Hangers: ASTM A 510, mild carbon steel.
 - a. Diameter: 1/4-inch.
 - b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
 - 3. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized.
 - 4. Angle Hangers: ASTM A 653/A 653M, hot-dip galvanized commercial-steel sheet.
 - a. Minimum Base Metal Thickness: 0.0312 inch.
 - b. Size: 2 by 2 inches.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch- wide flange, with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- 1. Depth: As indicated 2-1/2 inches.
- E. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- 1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, 3/4 inch deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base Metal Thickness: 0.0312 inch.
 - b. Depth: 2-1/2 inches.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0312 inch.

- F. Specialty Framing for Curved or Radius Assemblies:
 1. Basis of Design: Scafco Perfect Curve.

2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized, zinc coating.

- B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch.
2. Depth: As indicated.

- C. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

1. Product: Subject to compliance with requirements, provide one of the following:
 - a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
 - b. Metal-Lite, Inc.; Slotted Track.

- D. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the 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. Product: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - b. Metal-Lite, Inc.; The System.
 - c. Clark-Dietrich.

- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base Metal Thickness: 0.0312 inch.

- F. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.

1. Depth: 1-1/2 inches.
 2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch- thick galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0312 inch.
 2. Depth: 7/8 inch.
- H. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
1. Depth: 3/4 inch.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch- diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- K. Specialty Framing for Curved or Radius Assemblies:
1. Basis of Design: Scafco Perfect Curve.

2.4 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum Co.
 - b. G-P Gypsum.
 - c. Lafarge North America Inc.
 - d. National Gypsum Company.
 - e. USG Corporation.
- B. Type X:
1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.
 3. Location: Everywhere, unless noted otherwise.
- C. Water-Resistant Gypsum Board: ASTM C630/C 630M.

1. Core: 5/8 inch, Type X
2. Location: Toilets, showers, janitor closets, mechanical and electrical rooms, non-conditioned spaces.

D. Cementitious Tile Backing Panels: ANSI A118.9

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; Wonderboard
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. USG Corporation; DUROCK Cement Board.

E. Flexible Gypsum Panels for Curved or Radius Installations: ASTM C1396.

1. Core: 5/16-inch, Type X.
2. Location: As indicated in Drawings.

2.5 EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.

1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corp.
2. Core: 5/8 inch type X.
3. Additional Manufacturers:
 - a. National Gypsum
 - b. G-P Gypsum

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long leg receives joint compound.
 - d. Expansion (Control) Joint: Use where indicated Insert requirements.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead: Use at outside corners.
 - 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. Use where indicated.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
 - d. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Cementitious Tile Backing Panel: As recommended by panel manufacturer.
 - 4. Abuse Resistant Interior Gypsum Wallboard: As recommended by abuse resistant panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: 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.
 - 3. Cementitious Tile Backing Panel: As recommended by panel manufacturer.
- D. Joint Compound for Exterior Applications:
 - 1. Glass-Mat Gypsum Sheathing Board: As recommended by manufacturer.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. 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.
- E. 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.
- F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use proprietary deflection track.
 - b. Use proprietary firestop track.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in

form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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 support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Sway-brace suspended steel framing with hangers used for support.

D. For exterior soffits, install cross bracing and framing to resist wind uplift.

E. Wire-tie or clip furring channels to supports.

F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.

1. Hangers: 24 inches o.c.
2. Carrying Channels (Main Runners): 24 inches o.c.
3. Furring Channels (Furring Members): 24 inches o.c.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch short of full height to provide perimeter relief.
 2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
 - a. Terminate partition framing at suspended ceilings where indicated.
- D. Install steel studs and furring at the following spacings:
1. Single-Layer Construction: 16 inches o.c.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.
1. Install two studs at each jamb, unless otherwise indicated.
 2. 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.
 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- G. 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.
- H. Z-Furring Members:
1. Erect insulation vertically and hold in place with Z-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.
 4. Until gypsum board is installed, hold insulation in place with 10-inch staples fabricated from 0.0625-inch- diameter, tie wire and inserted through slot in web of member.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- K. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install gypsum panels over wood framing, with floating internal corner construction.
- M. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with

ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

- N. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
- O. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels vertically, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.

- 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
- 2. Fasten with corrosion-resistant screws.

D. Water Resistant Gypsum Board:

- 1. Water-Resistant Gypsum Board: Install at toilets, showers, locker rooms, janitor closets, non-conditioned spaces, electrical and mechanical rooms, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
- 2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

E. Cementitious Backer Units: ANSI A 108.11, at locations indicated to receive tile

- 1. Where cementitious tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform panel across plane.

3.8 INSTALLING TRIM ACCESSORIES

- A. General: 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.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated panels are substrate for acoustical tile indicated.
 - 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
 - 4. Level 5: At curved or radius installations.
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.

- b. Installation, insulation, and leak and pressure testing of water piping systems.
- c. Installation of air-duct systems.
- d. Installation of air devices.
- e. Installation of mechanical system control-air tubing.
- f. Installation of ceiling support framing.

END OF SECTION 092900

SECTION 093000 - TILING

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. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Metal edge strips.

- B. Related Sections:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the values as determined by testing identical products per ASTM C 1028:

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- D. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Stone thresholds in 6-inch lengths.
 - 5. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 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.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 1. Stone thresholds.
 2. Waterproof membrane.
 3. Crack isolation membrane.
 4. Joint sealants.
 5. Metal edge strips.
- D. 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. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site.
 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise 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 TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.
- D. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
- F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

- A. Floor Tile and Base Tile.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Olean; Division of Dal-Tile International Inc.

- b. Crossville, Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Interceramic.
 - f. Lone Star Ceramics Company.
 - g. Grupo Porcelanite.
 - h. Portobello America, Inc.
 - i. Seneca Tiles, Inc.
- 2. Module Size: As indicated on drawings.
 - 3. Tile Color and Pattern: As indicated on drawings.
 - 4. Grout Color: As indicated on drawings.
 - 5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

B. Wall Tile:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Marazzi Tile, Inc.
 - b. American Olean; Division of Dal-Tile International Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Florida Tile Industries, Inc.
 - f. Florim USA.
 - g. Laufen.
 - h. Grupo Porcelanite.
 - i. Portobello America, Inc.
 - j. Seneca Tiles, Inc.
 - k. United States Ceramic Tile Company.
- 2. Size: As indicated on drawings.
- 3. Tile Color and Pattern: As indicated on drawings.
- 4. Grout Color: As indicated by on drawings.
- 5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 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, with a minimum abrasion resistance of [10] [12] per ASTM C 1353 or ASTM C 241 and with honed finish.

- 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
 - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
 - c. Bostik, Inc.; Hydroment Blacktop 90210.
 - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
 - f. MAPEI Corporation; Mapelastick HPG with MAPEI Fiberglass Mesh.
 - g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
 - h. Summitville Tiles, Inc.; S-9000.
 - i. KBRS ShowerSeal.

2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
 - b. Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
 - c. Bostik, Inc.; Hydroment Blacktop 90210.
 - d. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
 - f. MAPEI Corporation; Mapelastick HPG with MAPEI Fiberglass Mesh.

- g. Mer-Kote Products, Inc.; Hydro-Guard 2000.
- h. Summitville Tiles, Inc.; S-9000.
- i. KBRs ShowerSeal.

2.6 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - 1. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
 - 2. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.
 - 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.7 GROUT MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Atlas Minerals & Chemicals, Inc.

- b. Boiardi Products; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Mer-Kote Products, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; a subsidiary of H. B. Fuller Company.
2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.
- B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC; a subsidiary of H. B. Fuller Company.

2.8 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 Section 079200 "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
 - b. Dow Corning Corporation; Dow Corning 786.
 - c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
 - d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
 - e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - f. Tremco Incorporated; Tremsil 600 White.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bonsal American; an Oldcastle company; Grout Sealer.
 - b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
 - c. C-Cure; Penetrating Sealer 978.
 - d. Custom Building Products; Grout and Tile Sealer.
 - e. Jamo Inc.; Penetrating Sealer.
 - f. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
 - g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
 - h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
 - i. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile swimming pool decks.
 - d. Tile floors in laundries.
 - e. Tile floors composed of tiles 8 by 8 inches or larger.
 - f. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Floor Tile: 1/4 inch.
 2. Wall Tile: 1/16 inch.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Tile Installation F112: Cement mortar bed (thickset) bonded to concrete; TCA F112 and ANSI A108.1A.
 - a. Tile Type: As indicated on drawings.
 - b. Grout: Water-cleanable epoxy grout, or sand-Portland cement.
 - 2. Tile Installation F115: Thin-set mortar; epoxy grout; TCA F115.
 - a. Tile Type: As indicated on drawings.
 - b. Thin-Set Mortar: Latex-portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout, or sand-portland cement.
- B. Interior Wall Installations, Metal Studs or Furring:
 - 1. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
 - a. Tile Type: As indicated on drawings.

- b. Thin-Set Mortar: Latex-portland cement mortar.
- c. Grout: Water-cleanable epoxy grout, or sand-portland cement.

C. Interior Wall Installations, Masonry or Concrete:

- 1. Tile Installation W202: Thin-set mortar; TCA W202.
 - a. Thin-Set Mortar: Latex-portland cement mortar.
 - b. Grout: Water-cleanable epoxy grout, or sand-portland cement.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordinate Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling suspension members.
 - 2. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Samples for Initial Selection: For components with factory-applied color finishes.

- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- F. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
 - 1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A, B, C materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
- B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and

ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels 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.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 3. Hold-Down Clips: Equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING ACT-1 AND ACT-2

- A. Products.
 - 1. Similar to Armstrong Optima Tegular, Fine Texture, 3354.
- B. Classification: Provide panels complying with ASTM E 1264 for Type XII, Form 2, Pattern E.
- C. Color:
 - 1. ACT 1: White
 - 2. ACT 2: Black
- D. LR: Not less than 0.90.
- E. NRC: Not less than 0.90.
- F. CAC: Not less than 26.
- G. Edge Detail: Tegular.
- H. Thickness: 1 inch.
- I. Size: 24 by 24 inches.
- J. Locations:
 - 1. ACT-1: See plans.
 - 2. ACT-2: See plans.

2.4 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING ACT-3

- A. Products.
 - 1. Similar to Armstrong Optima PB Vector Fine Texture.
- B. Classification: Provide panels complying with ASTM E 1264 for Type IV, Form 2, Pattern E.
- C. Color: White

- D. LR: Not less than 0.88.
- E. NRC: Not less than 0.90.
- F. CAC: Not less than 26.
- G. Edge Detail: 1/4- inch Reveal.
- H. Thickness: 7/8 inch.
- I. Size: 24 inches by 72 inches.
- J. Locations: See Plans.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.
- E. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653/A 653M, coating designation; with bolted connections and 5/16-inch- diameter bolts.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Products similar to Armstrong Prelude XL, 15/16”:
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with pre-finished 15/16-inch- wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel or aluminum cold-rolled sheet.
 - 5. Cap Finish: Painted in color as selected from manufacturer's full range.
 - 6. Color:
 - a. ACT 1 and 3: White
 - b. ACT 2: Black

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc.
 - 2. Celotex Corporation; Architectural Ceilings Marketing Dept.
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.
 - 6. MM Systems, Inc.
 - 7. USG Interiors, Inc.
- B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - 1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with the following requirements:
1. Aluminum Alloy: 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 aluminum extrusions complying with ASTM B 221 for alloy and temper 6063-T5.
 2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 3. 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.
 - a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels in a basket-weave pattern.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096400 – WOOD DANCE FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Provisions of Division 01 may apply to this section.
- B. SECTION INCLUDES
 - 1. A sprung dance floor system with a finished hardwood surface.
- C. RELATED SECTIONS (A cross-reference should be incorporated in these sections.)
 - 1. Section 033000: Cast-in-Place Concrete.
 - a. Concrete and Slab Construction: refer to ACI Code 302.1R-04.
 - b. Concrete Slab Depression: 3" (76mm) with 25/32" thick maple flooring.
 - c. Surface Finish: steel troweled and finished smooth.
 - d. Concrete Tolerance: +/- 1/8" (3mm) in radius of 10' (3m).
 - e. Floor Flatness and Floor Levelness (FF and FL) numbers are not recognized.
 - f. High spots shall be ground level and low spots shall be filled in with approved leveling compound by the general contractor to meet the tolerance above.
 - g. Compressive Strength: Concrete shall be a minimum of 3,000 psi (21 MPa) and a maximum of 4000 psi (28MPa) compressive strength after 28 days. Concrete shall be free of washed river gravel, pea gravel, flint or hardener additives. No lightweight concrete.
 - 2. Section 071000: Dampproofing and Waterproofing.
 - a. Concrete subfloors on or below grade shall be adequately waterproofed beneath the slab and at the perimeter walls and on the earth side of below grade walls by general contractor using suitable type membrane.
 - b. Sand-Poly-Sand slab construction is not an acceptable construction.
 - 3. Section 087100: Door Hardware
 - 4. Section 099123: Interior Painting
 - 5. Division 11: Equipment.

1.2 REFERENCES

- A. ANSI E1.26 -2006 (R2012): Entertainment Technology - Recommended Testing Methods and Values for Shock Absorption of Floors Used in Live Performance Venues
- B. FSC: Forest Stewardship Council®

1.3 SUBMITTALS

- A. Submit under provisions of Section 013300: Submittal Requirements.
- B. Specification: Robbins Performing Arts **Bio-Channel Classic for Dance Wood** specification sheet.
- C. Drawings: Submit Robbins Performing Arts **Bio-Channel Classic for Dance Wood** drawing.
- D. Material Sample: Submit one (1) sample of Robbins Performing Arts **Bio-Channel Classic for Dance Wood**.
- E. Maintenance Guidelines: Submit copy of Maintenance Instructions.

- F. Submit Robbins Technical Services "Concrete Guide Specification" for further information regarding conditions and requirements of concrete prior to installation.
- G. Installer and Manufacturer Qualifications: Documentation showing compliance with manufacturer and installer qualifications specified in the Quality Assurance paragraph.

1.4 QUALITY ASSURANCE

A. Floor System Manufacturers Qualifications

1. Basis of design shall be **Bio-Channel Classic for Dance Wood** floor system as provided by Robbins Performing Arts, www.robbinsdancefloors.com, (800-831-8987).
2. Manufacturer shall be an established firm experienced in field and have been in business for a minimum of ten (10) years; Robbins, Inc. or an approved equal.
3. Material other than those listed must be approved 10 days prior by written addendum. Materials from un-approved manufacturers will not be accepted.

B. Floor Contractor/Installer Qualifications and Certifications

1. The flooring contractor shall be a Robbins Accredited Installer and be on site for the duration of the floor installation; or, a contractor approved by Robbins Performing Arts.
2. Flooring contractor shall be an established firm experienced in field and have been in business or a minimum of ten (10) years; Robbins, Inc. or an approved equal.
3. Flooring contractor shall submit a list of at least three completed projects of similar magnitude and complexity completed under current corporate identity.
4. Flooring contractor shall be manufacturer trained.

C. Floor System Design

1. Resilient pad shall be made from 50 durometer EPDM rubber.
2. Resilient pad shall have built in stop blocks

D. Floor System Performance

1. **Bio-Channel Classic for Dance Wood** shall be tested for the following performance criteria:
 - a. ANSI E1.26 -2006 (R2012)

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall not be delivered, stored or installed until all masonry, painting, plastering, tile, marble and terrazzo work is complete, and all overhead mechanical work, lighting, other overhead units are installed. Room temperature of 55-80 degrees Fahrenheit (13 to 27 degrees Celsius) and relative humidity of 35-50 % are to be maintained. The building shall be enclosed and weather tight. Ideal installation/storage conditions are the same as those that will prevail when building is occupied
- B. Materials shall not be delivered, stored or installed at the installation location if the In-Slab relative humidity level for the concrete slab is above 85% using ASTM F 2170 In-Slab Relative Humidity test.

1.6 PROJECT CONDITIONS-SEQUENCY

- A. Do not install floor system until concrete has been cured 60 days and the requirements in

Article 1.5 are obtained.

- B. General Contractor is responsible to ensure slab is clean and free of all dirt and debris prior to floor installation beginning.
- C. Maintain room temperature at 55 to 80 degrees F (16 to 27 degrees C) for one week prior to delivery of materials, during installation, and after installation.
- D. Provide permanent electricity, heat, light, and ventilation 1 week prior to delivery of materials, during installation, and after installation. Maintain a temperature range of 55 to 80 degrees Fahrenheit (13 to 27 degrees Celsius) and a relative humidity range of 35 to 50%.
- E. Acclimatize wood flooring in accordance with period of time recommended by manufacturer. In applications in which very high or low levels of humidity are present, extend period of time accordingly.

1.7 WARRANTY

- A. Guarantee shall not cover damage caused in whole or in part by casualty, ordinary wear and tear, abuse, use for which material is not designed, faulty construction of the building, settlement of the building walls, failure of the other contractors to adhere to specifications, separation of the concrete slab and excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall, or any other source.
- B. Robbins Performing Arts hereby warrants the **Bio-Channel Classic for Dance Wood** material to be free from manufacturing defects for a period of 2 years. This warranty is in lieu of all other warranties, expressed or implied including but not limited to any warranty of merchantability or fitness for a particular purpose, and of any other obligations on the part of Robbins Performing Arts. In the event of breach of any warranty, the liability of Robbins Performing Arts shall be limited to repairing or replacing **Bio-Channel Classic for Dance Wood** material and system components supplied by Robbins Performing Arts and proven to be defective in manufacture, and shall not include any other damages, either direct or consequential.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Robbins Performing Arts, which is located at: 4777 Eastern Ave; Cincinnati, OH 45226; Toll Free Tel: 800-831-8987; Fax: 513-871-7998; Email:[request info \(info@robbinsdancefloors.com\)](mailto:requestinfo@robbinsdancefloors.com); Web:www.robbinsdancefloors.com
- B. Additional manufacturers:
 - 1. XXX
 - 2. XXX

2.2 MATERIALS

- A. Vapor Barrier
 - 1. 6-mil polyethylene.
- B. Subfloor
 - 1. Robbins Bio-Channels: engineered-wooden sleeper with 7/16" (11mm) EPDM Bio-Pads attached, factory encased in a steel channel. Sleeper must be free to move vertically within steel channel confines to assure proper uniformity of resiliency and function.
 - 2. 23/32" (18mm) structural rated sheathing, exposure 1 (CD-X).

- C. Surface
 - 1. 25/32" thick x 1.5" wide, 2nd and Better grade, Tongue and Grooved, End Matched, Kiln Dried Finger-Jointed Northern Hard Maple Flooring. Flooring same be graded and manufactured in accordance with industry standards. Flooring shall be design with flexibility cross cuts and built-in expansion technology. Flooring must be certified by the Forest Stewardship Council®
- D. Fasteners
 - 1. Subfloor Fasteners: 1 ¼ (2mm)" coated staples or equivalent.
 - 2. Flooring Fasteners: 2" (51mm) x 15 gauge barbed cleat or coated staple.
 - 3. Adhesive: Elastomeric subfloor adhesive.
 - 4. Optional Sleeper Anchors: Powers SPIKE® anchors and sleeves
- E. Finish Materials
 - 1. Robbins approved stain, seal and or finish.
- F. Perimeter Base
 - 1. 3" x 4" heavy duty ventilating type base with pre-molded outside corners.(Specify black or brown)

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect concrete slab for proper tolerance and dryness, and report any discrepancies to the general contractor and architect in writing. Slab will be level to within 1/8" (3mm) in a 10' (3m). Moisture content of the concrete slab not exceed 85% in accordance to ASTM F 2170 In-Slab Relative Humidity test.
- B. All work required to put the concrete subfloors in acceptable condition shall be the responsibility of the general contractor.
- C. Floor area shall be broom cleaned by general contractor.
- D. Verify that site conditions are acceptable for installation of wood flooring system.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding. Do not begin installation until substrates have been properly prepared.
- F. Installer shall document all working conditions provided in General Specifications prior to commencement of installation.

3.2 INSTALLATION

- A. Vapor Barrier
 - 1. Install polyethylene with joints lapped a minimum of 6" (150mm) and turned up at walls 4"(100mm).
- B. Subfloor
 - 1. Install Robbins resilient and force attenuation pads on sleepers per manufacturer's recommendations.
 - 2. Place Bio-Channels 16-1/16" (408mm) ON CENTER end-to-end staggering end joints in adjacent rows, perpendicular to the intended direction of the maple flooring. Gap the ends of the sleepers approximately ¼" (6mm). Provide 1-½" to 2" (40 to 50mm) expansion void at the perimeter and all vertical obstructions.
 - 3. Anchor Bio-Channels at predetermined locations.

NOTE: Anchor sleepers in 3 of the pre-determined holes, at both ends and in center. When shimming for leveling is necessary, anchor in all 5 holes.
NOTE: If extensive shimming is necessary, alternate anchoring 'non-standard' method may be necessary. Additional costs for this 'non-standard' method are to be borne by the purchaser.

4. Install stop blocking per manufacturer's recommendations.
5. Install 23/32" (18mm) plywood subfloor parallel to sleeper channels and securely fasten subfloor 6" (150mm) ON CENTER along each channel sleeper.

C. Flooring Surface

1. Machine fasten maple flooring to the subfloor with end joints properly driven up. Use Robbins recommended standard nailing schedule on continuous subfloor systems. In certain geographical regions and site conditions, additional intermediate expansion spacing may be required.
2. Provide 1.5" to 2" expansion void at the perimeter and all permanent vertical obstructions.

3.3 FINISHING

A. Sanding

1. Sand flooring with appropriate grit papers with drum sander, edger, buffer, and hand scraper.
2. Sand per manufacturer's texture recommendations as indicated in Article 2.2, E.
3. Examine floor area to insure the surface is acceptable for finishing. Floor shall present a smooth surface without drum stop marks, gouges, streaks or shiners.
4. Vacuum or tack to remove sanding dust and debris from entire surface.

B. Finishing

1. Inspect entire floor to be sure surface is ready to accept stain, seal and or finish. Floor should be free from dust and debris.
2. Apply stain, sealer, and finish per manufacturer's recommendations as indicated in Article 2.2, E. to provide approved finish appearance.
3. Buff and clean floor between coats.

3.4 INSTALLATION OF WALL BASE

- A. Install vent cove base anchored to walls with base cement or mechanical fastener. Use pre-molded outside corners and neatly mitered inside corner.

3.5 CLEANING AND PROTECTION

- A. Remove rubbish, debris, and waste material from work area and legally dispose.
- B. After floors are finished, area to be kept locked by general contractor to allow curing time for the finish. If after required curing time general contractor or owner requires use of the floor, he shall protect the floor by covering with non-fibered kraft paper or red rosin paper with taped joints, until acceptance by owner (or owner's agent) of complete dance floor. Take necessary precautions to prevent damage from dropped objects. Use breathable materials to cover installed wood flooring. Do not completely cover installed wood flooring, as moisture and color shading issues may arise.
- C. Clean floor surface using cleaning products recommended by flooring manufacturer.

3.6 INSTRUCTION

- A. Instruct Owner's designated representatives in flooring maintenance.

END OF SECTION 096400

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR 82-2001
PERMIT SUBMITTAL
APRIL 2024

096400-6

SECTION 096519 - RESILIENT FLOOR TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Luxury vinyl floor tile.
 - 2. Resilient wall base and accessories.
 - 3. Resilient stair treads.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
 - 1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
 - 2. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

- A. Colors and Patterns: Indicated on drawings.

2.3 RESILIENT WALL BASE

- A. Wall Base: ASTM F 1861.

1. AFCO-USA, American Floor Products Company, Inc.
2. Armstrong World Industries, Inc.
3. Azrock Commercial Flooring, DOMCO.
4. Burke Mercer Flooring Products.
5. Endura.
6. Estrie, American Biltrite (Canada) Ltd.
7. Johnsonite.
8. Marley Flexco (USA), Inc.
9. Mondo Rubber International, Inc.
10. Musson, R. C. Rubber Co.
11. Nora Rubber Flooring, Freudenberg Building Systems, Inc.
12. Pirelli Rubber Flooring.
13. Roppe Corporation.
14. Stoler Industries.
15. VPI, LLC, Floor Products Division.

B. Type (Material Requirement): TV (vinyl), TS (rubber, vulcanized thermoset), TP (rubber, thermoplastic).

C. Group (Manufacturing Method): I (solid, homogeneous).

D. Style:

1. Cove (with top-set toe).
2. Profiled, similar to Roppe Contours Fashion #85, PV6085.

E. Minimum Thickness:

1. Cove base; 0.125 inch.
2. Profiled base; Manufacturer's standard.

F. Height:

1. 4 inches for cove base.
2. 6" for profile base.

G. Lengths: Coils in manufacturer's standard length.

H. Outside Corners: Premolded.

I. Inside Corners: Premolded.

J. Surface: Smooth.

2.4 RESILIENT MOLDING ACCESSORY

A. Description: Reducer strip for resilient floor covering. Joiner for tile edges and carpet edges.

1. Burke Mercer Flooring Products.
2. Johnsonite.
3. Marley Flexco (USA), Inc.

4. Roppe Corporation.
 5. Stoler Industries.
- B. Material: Vinyl or Rubber.
- C. Profile and Dimensions: Manufacturer's standard.

2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. 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: 50 g/L.
 - b. Cove Base Adhesives: 50 g/L.
 - c. Rubber Floor Adhesives: 60 g/L.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

2.6 LUXURY VINYL FLOOR TILE

- A. Products: Subject to compliance with requirements, provide products by one of the following:
1. Mannington.
 2. Armstrong World Industries, Inc.
 3. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 4. Johnsonite; A Tarkett Company.
 5. Roppe Corporation, USA.
 6. Mohawk
 7. Forbo
- B. Tile Standard: ASTM F 1700.
1. Class: As indicated by product designations.
 2. Type: A, smooth surface.
- C. Thickness: Manufacturer's standard thickness for product specified.
- D. Size: See drawings.

E. Colors and Patterns: See drawings.

2.7 RESILIENT STAIR ACCESSORIES

A. Resilient Stair Treads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - c. Estrie Products International; American Biltrite (Canada) Ltd.
 - d. Flexco, Inc.
 - e. Johnsonite.
 - f. Mondo Rubber International, Inc.
 - g. Musson, R. C. Rubber Co.
 - h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - i. PRF USA, Inc.
 - j. R.C.A. Rubber Company (The).
 - k. Roppe Corporation, USA.
 - l. VPI, LLC; Floor Products Division.

B. Resilient Stair Treads Standard: ASTM F 2169.

1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Surface Design: Textured, similar to Rice Paper by Tarkett.

C. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.

D. Nosing Height: 1-1/2 inches.

E. Thickness: 1/4 inch and tapered to back edge.

F. Size: Lengths and depths to fit each stair tread in one piece.

G. Risers: Smooth, flat, toeless, height and length to cover risers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Thickness: 0.125 inch.

F. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 3. Moisture Testing:
 - a. Perform 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. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. 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.
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.

- G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

- A. Lay out 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 square with room axis in pattern indicated.
- B. Match 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.
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. 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, nonstaining marking device.
- F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere 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.

3.4 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.

- E. Premolded Corners: Install premolded corners before installing straight pieces.

3.5 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.
- 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.

3.6 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by Manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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 modular carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Existing flooring materials to be removed.
 - 3. Existing flooring materials to remain.
 - 4. Carpet tile type, color, and dye lot.
 - 5. Type of subfloor.
 - 6. Type of installation.
 - 7. Pattern of installation.
 - 8. Pattern type, location, and direction.
 - 9. Pile direction.
 - 10. Type, color, and location of insets and borders.
 - 11. Type, color, and location of edge, transition, and other accessory strips.
 - 12. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis of Design: J and J Flooring, Kinetex.
 - 1. Construction: Textile Composite.
 - 2. Backing: Polyester felt cushion.
 - 3. Dye Method: Solution dyed.
 - 4. Total Weight: 4.5 oz – 5.2 oz/square foot.
 - 5. Total Thickness: 0.205 inches.
 - 6. Dimensions: 24 inches x 24 inches
 - 7. Pile: Closed loop.
 - 8. See Drawings for specific products and locations.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- 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. 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 carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed 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 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. 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.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. 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.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. 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 097750 - MARLITE FIBERGLASS REINFORCED PANELS

PART 1 – GENERAL

1.1 SCOPE:

- A. FRP (Fiberglass Reinforced Plastic) wall panels for sanitary and /or decorative environments.

1.2 ENVIRONMENTAL CONDITIONS:

- A. Building should be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work

1.3 DELIVERY AND STORAGE OF MATERIALS:

- A. Materials are to be factory packaged on strong pallets. All materials are to be stored lying flat, under cover and protected from the elements. Panels should be allowed to acclimate to room temperature (70°) for 48 hours prior to installation.

1.4 WARRANTY

- A. All products shall be warranted to be free from defects for a period of 30 days after delivery.

PART 2 – PRODUCTS

2.1 BASIS OF DESIGN PRODUCT

- A. Subject to compliance with requirements, provide FRP Panels by Marlite or comparable product by one of the following:
 - 1. NUDO
 - 2. Crane Composites.
 - 3. Construction Specialties.

2.2 MATERIALS

- A. All Sanitary wall panels shall be:
 - 1. Marlite Standard™ Panels Smooth Surface Class “C” Rated Panel - Classic Colors
 - a. S490 N, Light Grey

- b. Panel Size, see drawings.

2.3 ACCESSORIES

- A. All trim specified shall be Extruded PVC with integral color as required.

- 1. Trim Profiles for .090" thick panels

- a. M 350 Inside Corner
- b. M 360 Outside Corner
- c. M 365 Division
- d. M 370 Edge

- 2. Outside Corner Guard

- a. M 961 PVC Outside Corner Guard

- 3. Trim Finishes

- a. White

- 4. Base Finish

- a. P 200 Black

Part 3 – EXECUTION

3.1 EXAMINATION

- A. Open cartons and carefully inspect all panels.
- B. Contact Marlite with questions or problems

3.2 PREPERATION

- A. Panels must be applied over a smooth, solid, flat, clean subwall such as drywall or plywood.

3.3 CONDITIONING

- A. Panels should be opened and allowed to acclimate for 48 hours prior to installation. Room temperature should be approximately 70° F.

3.4 INSTALLATION

- A. Install all panels in strict accordance with manufacturer's installation instructions.
- B. All moldings must provide for a minimum 1/8 inch expansion joint to insure proper installation.
- C. C-551 Marlite FRP Adhesive is available in 3 ½ gallon cans. A water-resistant, non-flammable adhesive, C-551 meets ASTM Specification C557.
- D. C-375 Marlite Construction Adhesive is available 3 ½ gallon cans. A strong, flexible, water-resistant, solvent based adhesive formulated for fast, easy application, C-375 meets ASTM Specification C557.

3.5 SEALAND

- A. Marlite® Brand MS-250 Clear Silicone Sealant
- B. Marlite® Brand MS-251 White Silicone Sealant

3.6 MAINTENANCE

- A. Wipe down using a damp cloth and mild soap solution or cleaner. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 097750

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete masonry units (CMU).
 - 2. Steel.
 - 3. Galvanized metal.
 - 4. Aluminum (not anodized or otherwise coated).
 - 5. Wood.
 - 6. Exterior gypsum board.
- B. Related Sections include the following:
 - 1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. ICI Paints.
 - 3. PPG Architectural Finishes, Inc.
 - 4. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 - 1. VOC Content: E Range of E2.

2.4 PRIMERS/SEALERS

- A. Alkali-Resistant Primer: MPI #3.
 - 1. VOC Content: E Range of E1.

B. Bonding Primer (Water Based): MPI #17.

1. VOC Content: E Range of E1.

2.5 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E1.

B. Cementitious Galvanized-Metal Primer: MPI #26.

1. VOC Content: E Range of E1.

C. Quick-Drying Primer for Aluminum: MPI #95.

1. VOC Content: E Range of E1.

2.6 EXTERIOR LATEX PAINTS

A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).

1. VOC Content: E Range of E1.

B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

1. VOC Content: E Range of E1.

2.7 EXTERIOR ALKYD PAINTS

A. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of E1.

2.8 ALUMINUM PAINT

A. Aluminum Paint: MPI #1.

1. VOC Content: E Range of E1 E2 E3.

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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Masonry (Clay and CMU): 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates 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 plates, machined surfaces, and similar items already in place that 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.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Aluminum Substrates: Remove surface oxidation.
- H. Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. All exposed, unfinished surfaces are to be painted.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Latex System: MPI EXT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex (flat).

B. Steel Substrates:

1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).

C. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).

D. Aluminum Substrates:

1. Alkyd System: MPI EXT 5.4F.
 - a. Prime Coat: Quick-drying primer for aluminum.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).

E. Exterior Gypsum Board Substrates:

1. Latex System: MPI EXT 9.2A.
 - a. Prime Coat: Exterior latex matching topcoat.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex (semigloss).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Aluminum (not anodized or otherwise coated).
 - 6. Gypsum board.
- B. Related Sections include the following:
 - 1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. ICI Paints.
 - 3. PPG Architectural Finishes, Inc.
 - 4. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - 4. Floor Coatings: VOC not more than 100 g/L.
 - 5. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 - 6. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 - 7. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - 8. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.

9. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

2. 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.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E2.

2.4 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 - 1. VOC Content: E Range of E1.
 - 2. Environmental Performance Rating: EPR 1.
- B. Interior Alkyd Primer/Sealer: MPI #45.
 - 1. VOC Content: E Range of E1.

2.5 METAL PRIMERS

- A. Quick-Drying Alkyd Metal Primer: MPI #76.
 - 1. VOC Content: E Range of E1.
- B. Cementitious Galvanized-Metal Primer: MPI #26.
 - 1. VOC Content: E Range of E1.
- C. Quick-Drying Primer for Aluminum: MPI #95.
 - 1. VOC Content: E Range of E1.

2.6 LATEX PAINTS

- A. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - 1. VOC Content: E Range of E1.
 - 2. Environmental Performance Rating: EPR 1.
- B. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. VOC Content: E Range of E1.
 - 2. Environmental Performance Rating: EPR 2.

2.7 ALKYD PAINTS

- A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 - 1. VOC Content: E Range of E1.
 - 2. Environmental Performance Rating: EPR 1.
- B. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).
 - 1. VOC Content: E Range of E1.

2.8 FLOOR COATINGS

- A. Interior Concrete Floor Stain: MPI #58.
 - 1. VOC Content: E Range of **E1**.
 - 2. Environmental Performance Rating: EPR 2.

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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 - G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - H. Aluminum Substrates: Remove surface oxidation.
 - I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. Electrical Work:
 - a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Horizontal Surfaces.
 1. Epoxy System:
 - a. Prime Coat: Epoxy, matching topcoat.
 - b. Topcoat: Epoxy, Gloss:
 - 1) S-W Armorseal 1000HS Epoxy Floor Coating, B67 2000 Series, at 3.0 to 5.0 mils dry, per coat.
- B. CMU Substrates:

1. Latex System: MPI INT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex semigloss.

- C. Steel Substrates:
 1. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd semigloss.

- D. Galvanized-Metal Substrates:
 1. Alkyd System: MPI INT 5.3C.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd semigloss.

- E. Aluminum (Not Anodized or Otherwise Coated) Substrates:
 1. Alkyd Over Quick-Drying Primer System: MPI INT 5.4J.
 - a. Prime Coat: Quick-drying primer for aluminum.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd semigloss gloss.

- F. Gypsum Board Substrates:
 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer matching topcoat.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex eggshell.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. CMU

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

- A. Master Painters Institute (MPI) Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

- B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anticorrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content of 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 content of not more than 250 g/L.
10. Flat Interior Topcoat Paints: VOC content of not more than 50 g/L.
11. Nonflat Interior Topcoat Paints: VOC content of not more than 150 g/L.
12. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
13. Clear Wood Finishes, Varnishes: 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 content of not more than 200 g/L.
20. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
21. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
2. 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.

D. Colors: Match Architect's samples.

2.2 BLOCK FILLERS

A. Epoxy Block Filler: MPI #116.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ICI Paints; Devoe Coatings, Devran 224HS, 224HS Paints; Devoe Coatings, Bar-Rust 231, 231 Paints; Devoe Coatings, Bar-Rust 236, 236 Devoe (Canada); Devoe, Devran High Build Epoxy, 224HS Devoe (Canada); ICI Devoe, Devran 224, 224KXXXX.
 - b. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Block Filler, 97-685.
 - c. Sherwin-Williams Company (The); Industrial & Marine, Kem Cati-Coat HS Epoxy Filler/Sealer, B24W400/V400 S.
2. VOC Content: Minimum E Range of E1.

2.3 EPOXY COATINGS

A. Epoxy, Cold-Cured, Gloss: MPI #77.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore & Co.; Polyamide Epoxy Coating, M36/M37.
 - b. ICI Devoe (Canada); ICI Devoe, Devran 724, 724-KXXXX Paints; Devoe/Fuller, Guardcote, DP34UXX Paints (Canada); Devoe Coatings, Devan 724, 724 Paints (Canada); Devoe, Tru Glaze, 4508.
 - c. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Cold Cured Gloss, 95-1.
 - d. Sherwin Williams.
2. VOC Content: Minimum E Range of E1.

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 work.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Masonry (Clay and CMU): 12 percent.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

- D. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance with specified requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Epoxy Coating System:

- a. Prime Coat: Epoxy block filler, MPI #116.
- b. Intermediate Coat: epoxy, cold-cured, gloss, MPI #77.
- c. Topcoat: Epoxy, cold-cured, gloss, MPI #77.

END OF SECTION 099600

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Markerboards.
 - 2. Tackboards.

1.3 DEFINITIONS

- A. Tackboard: Framed or unframed tackable surface.
- B. Visual Display Boards: Chalkboards, markerboards, and tackboards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include motor capacities and individual panel weights for sliding visual display units.
 - 2. Include computer system requirements for electronic markerboards.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show location of panel joints.
 - 2. Show location of special-purpose graphics for visual display surfaces.
 - 3. Include sections of typical trim members.
 - 4. Include wiring diagrams for motor-operated, sliding visual display units.
- C. Samples for Initial Selection: For each type of visual display surface indicated and as follows:
 - 1. Actual sections of porcelain-enamel face sheet tack assembly visual display fabric.
 - 2. Fabric swatches of vinyl- and polyester-fabric-faced tack assemblies.
 - 3. Samples of accessories involving color selection.
- D. Samples for Verification: For each type of visual display surface indicated and as follows:

1. Trim: 6-inch- long sections of each trim profile.
2. Rail Modular Support System: 6-inch- long sections.
3. Accessories: Full-size Sample of each type of accessory.

E. Maintenance Data: For visual display surfaces to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide fabrics with the surface-burning characteristics indicated, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
2. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces become slick or shiny.
 - c. Surfaces exhibit crazing, cracking, or flaking.
2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Product: Subject to compliance with requirements, provide product specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Hardboard: AHA A135.4, tempered.
- C. Particleboard: ANSI A208.1, Grade 1-M-1, made with binder containing no urea formaldehyde.
- D. Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- E. Cork Sheet: MS MIL-C-15116-C, Type II.
- F. Natural Cork Sheet: Seamless, single layer, compressed fine-grain cork sheet, bulletin board quality; face sanded for natural finish.
- G. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with flame-spread index of 25 or less when tested according to ASTM E 84.
- H. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.3 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021-inch- thick, porcelain-enamel face sheet with high low-gloss finish.
1. Manufacturers:
 - a. AARCO Products, Inc.
 - b. ADP/Lemco, Inc.
 - c. Bangor Cork Company, Inc.
 - d. Best-Rite Manufacturing.
 - e. Claridge Products & Equipment, Inc.
 - f. Egan Visual Inc.
 - g. Ghent Manufacturing Inc.
 - h. Marsh Industries, Inc.
 - i. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - j. PolyVision Corporation.
 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 TACK ASSEMBLIES

- A. Manufacturers:
1. A-1 Visual Systems.
 2. AARCO Products, Inc.
 3. ADP/Lemco, Inc.
 4. Bangor Cork Company, Inc.
 5. Best-Rite Manufacturing.
 6. Claridge Products & Equipment, Inc.
 7. Egan Visual Inc.
 8. Ghent Manufacturing Inc.
 9. Marsh Industries, Inc.
 10. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 11. PolyVision Corporation.
- B. Polyester-Fabric-Faced Tack Assembly: 1/8-inch- thick, polyester-fabric-faced cork sheet factory laminated to 3/8-inch- thick fiberboard backing.

2.5 MARKERBOARD AND TACKBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated.

1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- C. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
 2. End Stops: Located at each end of map rail.
 3. Map Hooks and Clips: Two map hooks with flexible metal clips.

2.6 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.7 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
- C. Examine walls and partitions for proper backing for visual display surfaces.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101400 - INTERIOR SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. A modular, frameless sign system with options for identification, informational, personnel, directory, directional and regulatory signage.

1.2 REFERENCES

- A. ANSI A117.1: Providing Accessibility and Usability for Physically Handicap People, 1986 edition.
- B. Department of Justice, Office of the Attorney General, "Americans with Disabilities Act", Public Law 101-336, (ADA).
- C. 2010 Standards for Accessible Design (SAD): The updated ADAAG (ADA Accessibility Guidelines), effective on March 15, 2011 and made mandatory on March 16, 2012.

1.3 GENERAL INFORMATION

- A. Signage under this section is intended to include items for identification, direction, control, and information within a building where installed as a complete integrated system from a single manufacturer.
- B. ADA Design Requirements:
 - 1. Provide signage that conforms to the requirements of all regulatory agencies holding jurisdiction.
 - 2. Comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG - <http://www.ada.gov/regs2010/2010ADASTandards/2010ADASTandards.htm>), effective in March 2011. Requirements include, but are not limited to the following:
 - a. Tactile copy must be all upper case and raised at least 1/32". Tactile characters must be sans serif, not italic, not oblique, script or highly decorative.
 - b. The stroke width of the upper case "I" has to be 15% of the letter height or less. The character width of the uppercase "O" must be between 55% and 100% of the height of the corresponding uppercase "I".
 - c. The copy height for tactile information must be between 5/8" and 2". If separate visual characters are provided, raised characters can be 1/2" and need not contrast with the background.
 - d. The distance between characters on tactile copy must be a minimum of 1/8" and a maximum of 4 times the character stroke width. These distances are measured between the closest points of adjacent characters.

- e. Spacing between lines of tactile copy needs to be a minimum of 135% and a maximum of 170% of the corresponding upper case “I” height (measured from baseline to baseline).
- f. Braille must be Grade II and positioned directly below the corresponding raised characters. If text is multi-lined, Braille is placed below the entire body of text and separated 3/8” from any other tactile characters and 3/8” minimum from raised borders and decorative elements.
- g. Visual characters and symbols, and their background, are to have a non-glare finish. The color of raised characters must contrast as much as possible with their background to make sure signs are more legible for persons with low vision.
- h. Pictograms, selected from International Standards, are to be located within a 6” vertical void and accompanying text descriptions are to be located directly below the pictogram.

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. Manufacturer's product literature indicating units and designs selected.
 - 2. Evidence of manufacturer's computerized data retrieval program for tracking of project for sign typography, message strip requirements and other pertinent data from schedule input to final computerized typography on finished product.
 - 3. Preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.
- C. Samples: One full size sign sample illustrating the design, construction, colors, tpestyles, mounting method and other details as specified. Provide sample in small size sign.
 - 1. Samples will not be returned for use in Project.
- D. Shop Drawings:
 - 1. Indicate materials, sizes, configurations, and applicable mountings.
 - 2. Typography sample for typical inserts.
 - 3. Artwork for special graphics.
 - 4. Artwork for special headers.
- E. Signage Schedule:
 - 1. Complete with location of each sign and the required copy/text.
- F. Sign Program Maintenance Plan:
 - 1. Manufacturer shall provide details of software and system of pre-perforated paper sign inserts allowing client to update and maintain signage graphics in-house.
 - 2. Manufacturer shall provide details of an Online Reordering & Maintenance Application whereby the client can submit sign reorders online and store relevant

project information such as sign type drawings, message schedules and product instructions.

- G. Contract close out:
 - 1. Furnish appropriate checklist for aiding in reordering after Date of Substantial Completion. Maintain computer schedule program for five years for ordering new signage required by Owner.
 - 2. Maintenance data and cleaning requirements for sign surfaces.
 - 3. Furnish one complete SignWord Pro software package compatible with Windows XP or newer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Work required under this section from manufacturer regularly engaged in work of this type and scope for a minimum of 5 years.
 - 2. Maintain computer link between schedule input and computerized typography production.
- B. Installer Qualifications: Trained and authorized by manufacturer for installations of required scope and product.

1.6 DELIVERY, STORAGE & HANDLING

- A. Package signs to prevent damage during shipment, handling, storage and installation. Products are to remain in their original packaging (unless otherwise specified) until removal is necessary for installation.
- B. If installation site is not ready for signage upon delivery, store signs in a dry, air-conditioned environment.
- C. Handle signage in accordance with manufacturer's instructions.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 SEQUENCING AND SCHEDULING

- A. Schedule system installation after room finishes and fixtures have been completed.

1.9 WARRANTY

- A. Product Warranty: Provide manufacturer’s warranty against defects in materials and workmanship for a minimum period of one year.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design Manufacturer: Signage shall be manufactured by APCO Graphics, Inc. (a.k.a. APCO Signs or APCO USA), at 388 Grant Street SE, Atlanta, GA 30312.
- B. Basis of Design Product: Elevate Frameless Modular Sign System
 - 1. 6”x6” sign with 3 equal height bands, 2 acrylic bands and 1 aluminum insert slot, and decorative aluminum divider bars

2.2 ALTERNATE MANUFACTURERS

- A. 2/90 SIGN SYSTEMS
- B. ASI
- C. MOHAWK
- D. TAKEFORM

2.3 SYSTEM REQUIREMENTS

- A. General:
 - 1. Sign system shall be frameless and shall feature solutions for all required sign types, including but not limited to wall mounted personnel signs, work station personnel signs, primary room identification, directories, directionals, overhead signs, projection wall signs, restroom signs, regulatory and information signs, stair signs and changeable slide conference room signs. All signs within the system must convey a uniform look throughout.
- B. Features:
 - 1. Sign Assembly:
Sign shall feature a fully recessed chassis to which modular display panels securely engage, creating a frameless look with the appearance that display panels are floating off of the mounting surface.
 - 2. Display Panels / Inserts:
Primary display panels shall be 1/8” thick painted acrylic plaques. Display panels engage with the concealed chassis in a precise manner to ensure a 1/16” reveal between all panels as a standard.
 - 3. Full Bleed Graphics:
System shall offer options for direct-print graphics that bleed around all four edges/returns of the display panels.
 - 4. Tamper Resistance:
System must offer an option for a concealed locking method to increase level of tamper resistance.
 - 5. Mounting:

Signs must be able to accommodate installation via fully concealed mechanical fasteners.

6. Modularity:
All display panels shall be securely engaged within a concealed chassis but must be easily updatable to accommodate change. Display panels must be removable without the use of a special, proprietary tool.
7. User Letter Paper Inserts:
System must offer solutions for user updatable paper inserts, including a range of perforated, coated paper and free software with templates for easy creation of graphics.

C. Graphics and Typography:
As selected from manufacturer's standards. Reference Signage Schedule in Appendix E.

D. Colors and Finishes:
As selected from manufacturer's standards. Reference Signage Schedule in Appendix E.

E. ADA Compliance:
Sign system shall comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG), effective in March 2011. This includes requirements regarding which sign types require Braille/tactile features, character heights, raised character spacing, raised character stroke width, color contrast and installation locations and mounting heights within the facility.

- F. Materials and Construction:
1. Sign shall feature a fully recessed black anodized aluminum chassis to which modular display panels securely engage. Chassis shall be no more than 3/8" in depth and shall be recessed sufficiently behind the panels to give the appearance the panels/inserts are floating off of the mounting surface.
 2. Primary display panels shall be 1/8" thick painted acrylic. Display panels must securely engage with the recessed chassis via a concealed attachment method but should be 100% modular to accommodate changes.
 3. System shall offer a range of aluminum bands to house user-updatable, perforated paper inserts. Inserts shall be retained on the left and right sides of the aluminum band by .020" clear, flexible end caps.
 4. Standard ADA inserts/plaques are acrylic or aluminum with APCO's DP-Tactile process direct-print, UV-cured 1/32" thick tactile characters and fully domed Braille.
 5. Standard graphics are UV-cured, direct-print with true 600dpi resolution and the option to bleed around all four edges/returns of the ACM display panels.
 6. Attachment: Signs shall be able to accommodate fully concealed mechanical fasteners.

2.4 Elevate Sign System Components

- A. Sizes and Configurations:
1. Custom configurations with the following widths and variable heights. Insert/display components are specified in Section D following.
 - a. 6" (EV06)

- B. Tamper Proof Feature
 - 1. Signs are to use the optional Tamper-Proof feature.

- C. Insert/Display Components to Include:
 - 1. Acrylic Color Band (EV-ACR):
1/8" thick acrylic panel with painted edge/background and direct print graphics.
 - 2. ADA Color Band (EV-341A-DPT):
1/8" thick acrylic with APCO's DP-Tactile process direct-print, UV-cured, 1/32" thick tactile characters and fully domed Braille.
 - 3. Decorative Aluminum Divider Bar:
 - a. (EV-DBL-NR): 1/4" x 1/4" thick divider with NO inter-insert reveals.
 - 4. Aluminum InsertSlot (EV-IS):
Extruded aluminum InsertSlot to accept perforated paper inserts with non-glare protective overlays. InsertSlots feature flexible, .020" clear plastic end caps to retain the paper on both sides of the band. Select from the following sizes:
 - a. 2" h (EV-IS20) by 6"

- D. Standard Elevate Assembly Mounting Options:
 - 1. Concealed Mechanical Fasteners (MF)

- E. Graphics
 - 1. Type Sizes:
Selected from manufacturer's standard sizes indicated, meet ADA requirements for letter proportions and sizes.
 - 2. Typography:
Font(s) selected from manufacturer's standards unless otherwise specified. All text and graphics shall be a true representation of the typeface(s) and/or graphics specified. Letter spacing and interline spacing shall be set by the manufacturer.
 - a. HelveticaNeue-Roman (HR)
 - 3. Type Code(s): Uppercase.
 - 4. Imprint Colors:
Selected by Architect from manufacturer's standard or PMS colors, color contrast background colors in accord with ADA requirements.
 - 5. Copy/Message List: As selected by Architect. See Appendix E.
 - 6. All text and graphics shall be a true representation of typeface(s) and/or graphics specified.

2.5 FABRICATION

- A. Fabricate units as per specifications and details indicated on reviewed drawings.
- B. All fabrication must take place in the USA.
- C. Include product instructions sheets for installation and removal/replacement of insert components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, in locations and with mounting methods as specified in sign and location drawings. Provide signage at all interior and exterior rooms, exit stairs, and toilets.
- B. Square, plumb and level all installed products.
- C. Install all signage in accordance with the 2010 Standard for Accessible Design (SAD) effective in March 2011, and any applicable local regulations and/or codes.
- D. Upon completion of the work, sign installer shall remove any unused products, materials, packaging and debris from the installation site.

3.4 CLEANING

- A. Clean all exposed surface not more than 48 hours prior to Date of Substantial Completion in accordance with manufacturer's written cleaning instructions.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 101400

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

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. Cast dimensional characters.

1.3 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter signs.
 - 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.
 - 4. Show locations of electrical service connections.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) to withstand design loads as indicated on Drawings.
- B. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 DIMENSIONAL CHARACTERS

- A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ACE Sign Systems, Inc.
 - b. Allen Markings International.
 - c. APCO Graphics, Inc.
 - d. A. R. K. Ramos Signage Systems.
 - e. ASI Sign Systems, Inc.
 - f. Diskey Sign Company.
 - g. Gemini Incorporated.
 - h. Matthews International Corporation; Bronze Division.
 - i. Metal Arts; Division of L & H Mfg. Co.
 - j. Metallic Arts.
 - k. Seton Identification Products.
 - l. Southwell Company (The).
 2. Character Material: Cast aluminum.
 3. Character Height: 18”.
 4. Thickness: Manufacturer's standard for size of character.
 5. Finishes:
 - a. Integral Aluminum Finish: Medium bronze anodized.
 6. Mounting: Projecting studs.
 7. Typeface: Palatino

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

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 nonferrous-metal devices unless otherwise indicated.
 - 3. Sign Mounting Fasteners:
 - a. 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.
- B. 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. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace signs for stability and for securing fasteners.
 - 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 Method:
 - 1. Projecting 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 spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101550 PHENOLIC CORE FULL-HEIGHT PRIVACY TOILET PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic core full-height privacy toilet partitions.

1.2 RELATED SECTIONS

- A. Section 092900 – Gypsum Board Assemblies.
- B. Section 061000 – Rough Carpentry: Concealed wood blocking for compartment support.
- C. Section 102800 - Toilet and Bath Accessories.

1.3 REFERENCES

- A. ASTM International: ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

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. Literature indicating typical panel, pilaster, door, hardware and fastening.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings:
 - 1. Dimensioned plans indicating layout of toilet compartments.
 - 2. Dimensioned elevations indicating heights of doors, pilasters, separation partitions, and other components; indicate locations and sizes of openings in compartment separation partitions for toilet and bath accessories to be installed in partitions; indicate floor and ceiling clearances.
 - 3. Details indicating anchoring components (bolt layouts) and methods for project conditions; indicate components required for installation, but not supplied by toilet compartment manufacturer.
- D. Selection Samples: For each finish product specified, one complete set of color selection guides representing manufacturer's full range of available colors, textures and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, texture and pattern.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.
- B. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.
- C. Lay cartons flat, with adequate support to ensure flatness and to prevent damage to pre-finished surfaces.
- D. Do not store where ambient temperature exceeds 120 degrees F (49 degrees C).

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.
- B. Do not deliver materials or begin installation until building is enclosed, with complete protection from outside weather, and building temperature maintained at a minimum of 60 degrees F (15.6 degrees C).

1.7 WARRANTY

- A. Manufacturers Standard Warranty: Provide warranty for Phenolic Material against delamination, breakage, or corrosion for 10 years, assuming proper maintenance according to manufacturer's recommendations.

1.8 COORDINATION

- A. Coordinate Work with placement of support framing and anchors in walls and ceilings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: ASI-Global Partitions, which is located at: 900 Clary Connector; Eastanollee, GA 30538; Tel: 706-827-2700; Fax: 706-827-2710;
- B. Additional Manufacturers:
 - 1. Accurate
 - 2. Ampco
 - 3. Bradley
 - 4. Capitol
 - 5. Santana

2.2 COMPARTMENTS AND SCREENS

- A. Toilet Compartments: Floor anchored/overhead braced—**Alpaco Elegance**
 - 1. Compartment Depth and Width: As scheduled and indicated on Drawings.
 - 2. Door Width: 24 inches (610 mm), minimum; at ADA accessible compartments 36 inches (915 mm) minimum. Door height to be 2 meters or 78.7 inches high.
 - 3. Pilaster Height: 2 meters or 78.7 inches.
- B. Privacy and Urinal Screens: Wall hung.
 - 1. Height Above Floor: 4, 6, or 9 inches as plumbing placement and compliance with applicable accessibility guidelines permit.

2.3 SOLID PHENOLIC

- A. Doors, Panels, Screens, and Pilasters: Decorative surface sheet with solid phenolic core of melamine resin impregnated kraft paper fused under high temperature and pressure; edges machine sanded with a filleted edge. Manufacturer's standard.
 - 1. Doors and Pilasters: 1/2 inch (13 mm) thick.
 - 2. Panels and Screens: 1/2 inch (13 mm) thick.
 - 3. Doors, panels and pilasters: 78.7 inches (2 meters) high
 - 4. Door and pilaster edges shall be routed and overlapped to block sight lines into the compartments.
 - 5. Edges: Black core.
- B. Finish: Solid phenolic, as selected from manufacturer's standard colors.
- C. Door Hardware:
 - 1. Hinge: Three (3) surface mounted barrel hinges formed from 304 stainless steel.
 - 2. Latch: Type 304 stainless steel with indicator of occupancy. Latch to be mounted to the pilaster with integrated function as keeper for in-swinging doors. Latch will provide emergency access through an accessible slotted center pin in the external indicator.
 - 3. Coat Hook and Bumper: Type 304 stainless steel with black rubber tip for doorstop.
 - 4. Fastening Hardware: Manufacturer's standard, Type 304 stainless steel, No. 4 satin finish. Door hardware will be attached to holes predrilled at the manufacturing facility.
- D. Mounting Brackets: Provide stainless steel continuous bracket Type 304 stainless steel, No. 4 satin finish, with stainless steel theft-resistant barrel nuts and machine screws of same material and finish.
- E. Headrail: Type 304 Stainless Steel 1 ¼" diameter tube attached in clips to top of pilaster.
- F. Floor Anchored/Overhead Braced.
 - 1. Compartment to be supported by Type 304 Stainless steel pedestal placed under the panels approximately 12" behind pilaster on standard compartments. ASI-Global Partitions will recommend placement of pedestal under large pilasters associated with accessible compartments.
 - 2. Pedestal to be adjustable in height plus or minus 1 inch to compensate for uneven floors.
 - 3. Pedestal to support panel 4, 6, or 9 inches above finished floor.
 - 4. Pedestal to be secured to floor with 2 1/2 inch corrosion resistant screws.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions. Clean surfaces thoroughly prior to installation.
- B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
 - 1. Verify dimensions of areas to receive compartments.
 - 2. Verify locations of built-in framing, anchorage, bracing, and plumbing fixtures.

3.2 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturer's instructions.
- B. Fasten components to adjacent materials and to other components using purpose-designed fastening devices.
- C. Adjust pilaster anchors for substrate variations.
- D. Equip each compartment door with hinges and door latch.
- E. Equip each compartment door with one coat hook and bumper.
- F. Installation Tolerances:
 - 1. Maximum variations from plumb or level: 1/8 inch (3 mm).
 - 2. Clearance between wall surface and panels or pilasters: 1-1/2 inch (38 mm) maximum.

3.3 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors.
- B. Adjust adjacent components for consistency of line or plane.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Remove factory protective coverings and clean finish surfaces in accordance with manufacturer's instructions before substantial completion.

END OF SECTION 101550

SECTION 102113 - TOILET COMPARTMENTS

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 solid-polymer units as follows:
 - 1. Toilet Enclosures: Overhead braced Floor anchored.
 - 2. Entrance Screens: Overhead braced Floor anchored.
 - 3. Urinal Screens: Wall hung.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for blocking.
 - 2. Division 10 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
- C. Samples for Initial Selection: For each type of unit indicated.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.

1.4 QUALITY ASSURANCE

- A. Comply with requirements in CID-A-A-60003, "Partitions, Toilets, Complete."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Ampco.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. Capitol Partitions, Inc.
 - 5. Comtec Industries.
 - 6. General Partitions Mfg. Corp.
 - 7. Global Steel Products Corp.
 - 8. Metpar Corp.
 - 9. Santana Products, Inc.
 - 10. Sanymetal; a Crane Plumbing Company.
 - 11. Weis-Robart Partitions, Inc.
- B. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE), panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: as selected by Architect from manufacturer's full range of colors and patterns.
- C. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- D. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- E. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.

- F. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Support Posts for Urinal Screens: Manufacturer's standard aluminum post with floor shoe for anchoring to floor construction.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Doors: 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 indicated to be accessible to people with disabilities.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance screen doors.

5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

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.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor, unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Wall-Hung and Post-Supported Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to 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 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Washroom accessories.
 - 2. Under lavatory guards.
 - 3. Custodial accessories.
 - 4. Childcare Accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- 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.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. General Accessory Manufacturing Co. (GAMCO).
- B. Toilet Tissue (Roll) Dispenser:
 - 1. Description: Double-roll dispenser.
 - 2. Mounting: Surface mounted.
 - 3. Operation: Noncontrol delivery with standard spindle.
 - 4. Capacity: Designed for 4-1/2- or 5-inch-diameter tissue rolls.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 6. Basis of Design: Bobrick B-69997.
- C. Paper Towel (Folded) Dispenser:
 - 1. Mounting: Surface mounted.
 - 2. Minimum Capacity: 200 C-fold or 275 multifold towels.
 - 3. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 4. Lockset: Tumbler type.
 - 5. Refill Indicators: Pierced slots at sides or front.
 - 6. Basis of Design: Bobrick B-2621.
- D. Combination Towel (Folded) Dispenser/Waste Receptacle:
 - 1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - 2. Mounting: Recessed.
 - a. Designed for nominal 4-inch 6-inch wall depth.
 - 3. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 - 4. Minimum Waste-Receptacle Capacity: 4 gal.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 6. Liner: Reusable, vinyl waste-receptacle liner.
 - 7. Lockset: Tumbler type for towel-dispenser compartment.
 - 8. Basis of Design: Bobrick B-3942.

E. Liquid-Soap Dispenser:

1. Description: Designed for dispensing soap in liquid or lotion form.
2. Mounting: Vertically oriented, surface mounted.
3. Capacity: Manufacturer's standard.
4. Materials: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.
7. Basis of Design: Bobrick B-2111.

F. Grab Bar:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
3. Outside Diameter: 1-1/4 inches.
4. Configuration and Length: As indicated on Drawings.
5. Basis of Design: Bobrick B-9806

G. Mirror Unit:

1. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
3. Size: 24"x48".
4. Basis of Design: Bobrick B-290-2448.

H. Sanitary-Napkin Disposal Unit:

1. Mounting: Surface mounted.
2. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
5. Basis of Design: Bobrick B-254.

2.3 UNDERLAVATORY GUARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Plumberex Specialty Products, Inc.
 2. TCI Products.
 3. Truebro, Inc.
- B. Underlavatory Guard:
1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
 2. Material and Finish: Antimicrobial, molded-plastic, white.

2.4 CUSTODIAL ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. General Accessory Manufacturing Co. (GAMCO).
- B. Mop and Broom Holder:
1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf Insert description.
 2. Length: 36 inches.
 3. Hooks: Three.
 4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
 - b. Rod: Approximately 1/4-inch- diameter stainless steel.
 6. Basis of Design: Bobrick B-239x34.

2.5 CHILDCARE ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. American Specialties, Inc.
 2. Brocar Products, Inc.
 3. Diaper Deck & Company, Inc.

4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.
6. SSC, Inc.
7. Tubular Specialties Manufacturing, Inc.

B. Diaper-Changing Station:

1. Basis-of-Design Product: Bobrick KB310-SSWM.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104416 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Mounting brackets for fire extinguishers.
 - 3. Fire extinguisher cabinets.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for firestopping sealants at fire-rated cabinets.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.
- C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
 - 1. Size: 6 by 6 inches square.
- D. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.
- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Amerex Corporation.
 - 2. Ansul Incorporated.
 - 3. Badger Fire Protection.
 - 4. Buckeye Fire Equipment Company.
 - 5. Fire End & Croker Corporation.
 - 6. General Fire Extinguisher Corporation.
 - 7. JL Industries, Inc.
 - 8. Kidde Fynetics.
 - 9. Larsen's Manufacturing Company.
 - 10. Modern Metal Products; Div. of Technico.
 - 11. Moon American.
 - 12. Potter Roemer; Div. of Smith Industries, Inc.
 - 13. Watrous; Div. of American Specialties, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Valves: Manufacturer's standard.
 - 2. Handles and Levers: Manufacturer's standard.
 - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- C. Multipurpose Dry-Chemical Type: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.4 FIRE-PROTECTION CABINET

- A. Manufacturers:
 - 1. Fire End & Croker Corporation.
 - 2. General Accessory Mfg. Co.
 - 3. JL Industries, Inc.
 - 4. Kidde Fynetics.
 - 5. Larsen's Manufacturing Company.
 - 6. Modern Metal Products; Div. of Technico.

7. Moon American.
 8. Potter Roemer; Div. of Smith Industries, Inc.
 9. Watrous; Div. of American Specialties, Inc.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Construction: 1-hour fire rated.
- D. Cabinet Material: Stainless-steel sheet.
1. Shelf: Same metal and finish as cabinet.
- E. Semirecessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- F. Cabinet Trim Material: Stainless-steel sheet.
- G. Door Material: Stainless-steel sheet.
- H. Door Style: Fully glazed panel with frame.
- I. Door Glazing: Wire glass.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide manufacturer's standard.
 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- K. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened, Engraved, Decals.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- L. Finishes:

1. Stainless Steel: Satin finish.

2.5 MOUNTING BRACKETS

A. Manufacturers:

1. Amerex Corporation.
2. Ansul Incorporated.
3. Badger Fire Protection.
4. Buckeye Fire Equipment Company.
5. Fire End & Croker Corporation.
6. General Fire Extinguisher Corporation.
7. JL Industries, Inc.
8. Larsen's Manufacturing Company.
9. Potter Roemer; Div. of Smith Industries, Inc.

B. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Color: Black.

2.6 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. 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.

2.8 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Satin, Directional Polish: No. 6 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below, acceptable to authorities having jurisdiction.
 - 1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
 - 2. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. Identification: Apply decals vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104416

SECTION 105300 - METAL AWNINGS AND CANOPIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal Awnings and Canopies of the following types:
 - 1. Standard Canopy with Channel Fascia.

1.2 RELATED SECTIONS

- A. Section 051200 - Structural Steel.
- B. Section 054000 - Cold-Formed Metal Framing.
- C. Section 061000 – Rough Carpentry
- D. Section 072726 – Weather Barriers
- E. Section 076200 - Sheet Metal Flashing and Trim.
- F. Section 079200 – Joint Sealants
- G. Section 092350 – Gypsum Sheathing

1.3 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Typical installation methods.
- C. Verification Samples: Two representative units of each type, size, pattern and color.
- D. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience with projects of similar scope and complexity, and approved by Manufacturer.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.
- D. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
 - 1. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
 - 2. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
 - 3. Retain mock-up during construction as a standard for comparison with completed work.
 - 4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene a conference approximately two weeks before scheduled commencement of the Work. Attendees shall include Architect, Contractor and trades involved. Agenda shall include schedule, responsibilities, critical path items and approvals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

- A. Manufacturer's Warranty: Aluminum frames are warranted against defects in workmanship for five (5) years from date of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Lawrence Fabric and Metal Structures Inc., which is located at: 3509 Tree Court Industrial Blvd.; St. Louis, MO 63122; Phone: 636-861-0100; Email: sales@lawrencefabric.com; Web: lawrencefabric.com.
- B. Additional Manufacturers:
 - 1. Mapes
 - 2. Mitchell Metals
 - 3. Dittmer Architectural Aluminum
 - 4. Peachtree Protective Covers

2.2 METAL AWNINGS AND CANOPIES

- A. Performance and Design Requirements:
 - 1. Standards Compliance: Comply with local building codes.
- B. Standard Canopy, Basis of Design: LFS-FLCA Canopy; as manufactured by Lawrence Fabric and Metal Structures Inc.
 - 1. Material: Extruded aluminum, alloy 6063-T6.
 - 2. Fabrication Method: Welded and mechanically fastened
 - 3. Fascia: G-style gutter fascia
 - a. Welded as one piece or in sections as required for width of canopy.
 - b. Profile: 12 inches and 36 inches, see Drawings.
 - 4. Decking: Aluminum Interlocking Pan.
 - a. Profile: Profile: 3x6 Inch
 - 5. Water Dispersal:
 - a. Include scupper(s)
 - 6. Support: Hanger rods:
 - a. 1.0 Inches Stainless Steel Rod with Clevis Assembly
 - 7. Finishes
 - a. AAMA 2605 AAMA 2605 Compliant Finish: 10-Year Warranty
 - b. Color: As selected by Architect from Manufacturer's full range of standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. Confirm dimensions and elevations.
- C. Verify that wall structure can support canopy loads.
- D. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

3.4 CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturer's recommendations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 105300

SECTION 122124 - MANUAL AND ELECTRONIC INTELLIGENT ROLLER SHADE SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Provide electrically operated sunscreen roller shades as applicable. Work includes local, group and master control systems for shade operation with addressable, encoded, electronic drive units (EDU).
- B. Related Sections:
 - 1. Division 09 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for blocking, installation of shade pockets, closures and related accessories.
 - 2. Division 09 - Acoustical Ceilings: Coordination with acoustical ceiling systems for blocking, installation of shade pockets, closures and related accessories.
 - 3. Division 26 - Electrical: Electric service for EDU's, and EDU controls, internal communication, low voltage wiring and data transfer, and connection to the Internet and required.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 3. Storage and handling requirements and recommendations.
 - 4. Mounting details and installation methods.
 - 5. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.
- B. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.
 - 1. Prepare shop drawings on AutoCAD format using base sheets provided electronically by the Architect.
 - 2. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.
 - 3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
- C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- D. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade cloth samples and aluminum finish sample as selected. Mark face of material to indicate interior faces.

- E. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- F. Warranty: Provide manufacturer's warranty documents as specified in this Section.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.
- B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components, with the following qualifications.
 - 1. Installer for roller shade system shall be trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components shall be FCC compliant.
- E. Requirements for Electronic Hardware, Controls, and Switches:
 - 1. Roller shade hardware, shade fabric, EDU, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Power and control wiring shall be complete and certified, fully operational with uninterrupted communication on the lines and minimal noise certified by a commissioning agent (engaged by others).
 - 1. 485, ICON, Lonmark and Dry Contract Network: Noise on the line not to exceed shade manufacturer's limits.

1.6 WARRANTY

- A. Warranty: Provide manufacturer's standard warranties, including the following:
 - 1. Roller Shade Hardware, and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
 - a. EcoVeil standard non-depreciating 10-year limited warranty.
 - 2. Electronic Roller Shade EDU's and EDU Control Systems: Manufacturer's standard non-depreciating five-year warranty.
 - 3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to access to the work above 12' Feet AFF, which are the responsibility of others.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Manufacturer for Window Shade System: Products by MechoSystems; 42-03 35th Street, Long Island City, NY 11101. Tel: (718) 729-2020 ext 1901; Mr. Glen Berman. Email: glenb@MechoSystems.com.

2.2 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

- A. Electronic Drive Unit (EDU):
 - 1. Intelligent Encoded EDU, and Control System: Tubular, asynchronous (non-synchronous) EDU's, with built-in reversible capacitor operating at 120VAC/60Hz, (230VAC/50Hz) single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each EDU.
 - 2. Quiet [42 – 46 db] (within 3 feet open air).
 - 3. Conceal EDU's inside shade roller tube.
 - 4. Maximum current draw for each shade EDU of 0.9Amps at 120VAC.
 - 5. Use EDU's rated at the same nominal speed for all shades in the same room.
 - 6. Use EDU's with minimum of 34RPM, that shall not vary due to load / lift capacity.
 - 7. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade EDU and tube assembly.

- B. EDU System: (software, two-way communication): Specifications and design are based on the Intelligent EDU Control System, WhisperShade®IQ® System) as manufactured by MechoSystems. Other systems may be acceptable providing all of the following performance capabilities are provided. EDU and control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
 - 1. EDU shall support two methods of control.
 - a. Local Dry Contact Control Inputs:
 - 1) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to the upper and lower limits.
 - 2) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to local switch preset positions.
 - 3) Shall support configuring the EDU under protected sequences so that a typical user would not change the EDU's setup. At a minimum the

- configuration should include setting limits, setting custom presets and configuring key modes of operation.
- b. Network Control:
 - 1) EDU shall be equipped with a bi-directional network communication capability in order to support commanding the operation of large groups of shades over a common backbone. The network communication card shall be embedded into the tubular EDU assembly.
 2. Upper and lower stopping points (operating limits) of shade bands shall be programmed into EDU's using either a hand held removable program module / configurator or a local switch.
 3. Alignment Positions: Each EDU shall support a minimum of 133 repeatable and precisely aligned shade positions (including limits and presets).
 - a. All shades on the same switch circuit or with the same network group address with the same opening height shall align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
 - b. Shades of differing heights shall have capability for custom, aligned intermediate stop positions when traveling from any position, up or down.
 - c. Alignment of shades mechanically aligned on the same EDU shall not exceed +/- 0.125 inches (3.175mm) when commanded to the same alignment position.
 - d. Alignment of shades on adjacent EDU's shall not exceed +/- 0.25" inches (6.35mm) when commanded to the same alignment position.
 - e. Local Switch Presets: A minimum of 3 customizable preset positions shall be accessible over the local dry contact control inputs and over the network connection.
 - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to 25%, 50% and 57% of the shade travel.
 - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator or local switch shall be capable of customizing the position of these presets.
 - f. Network Presets: A minimum of 29 customizable preset positions (including the 3 local switch presets) shall be accessible via network commands.
 - 1) Upon setting the limits for the shade EDU these preset positions shall automatically default to the lower limit unless customized elsewhere.
 - 2) These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator shall be capable of customizing the position of these presets.
 4. Network Control:
 - a. The system shall have the capability of two-way digital communication with the EDU's over a common backbone.
 - b. Each EDU shall possess 8 addresses capable of being employed for various levels of group control. These addresses shall be configurable via a handheld configurator and/or a PC controller. A 9th unique address shall enable the EDU(s) to be independently controlled and configured over the network via a handheld configurator and/or a PC controller.
 - c. Low Voltage Communication Network Implementation.
 - 1) The low voltage network shall employ a bus topology with daisy chained network connections between nodes over a CAT5 cable (4 UTP) or over

- a 2 UTP cable employing at least 1 pair at 16 AWG for power and 1 pair at 22 AWG for data.
- 2) The low voltage network (+/- 13VDC) shall be powered by the nodes attached to it. These nodes could be line voltage powered EDU's attached to 120 VAC or 230 VAC. Alternatively, low voltage nodes shall be powered typically by a centralized low voltage power supply. If a CAT5 network cable is employed and the node draws less than 1W then the node may be powered by DC power supplied by an associated line voltage EDU.
- 3) Network Capacity: 4000 ft max, 250 nodes max
 - (a) The number and size of a centralized DC supply shall vary depending upon the network requirements.
- 5. Operating Modes:
 - a. Uniform or Normal Modes of Operation:
 - 1) Uniform mode shall allow for shades to only move to defined intermediate stop positions to maintain maximum uniformity and organization.
 - 2) Normal Mode shall allow for shades to move to both intermediate stop positions, plus any position desired between the upper and lower limits as set by the installer.
- 6. Wall Switches:
 - a. Conference Center: Shades shall be operated by, 5, 7, or 10-button low voltage standard switches, or programmable intelligent switches [IS]. Standard switch shall be wired to a bus interface and the bus interface will be programmed to transmit an address for the local switch.
 - b. Intelligent switches may be installed anywhere on the bus line. Each IS shall be capable of storing one control level address to be broadcast along the bus line.
 - c. An address that is transmitted by either a switch or central controller shall be responded to by those EDU's with the same address in their control table.
 - d. IS shall provide for interface with other low voltage input devices via a set of dry contact terminals located on the switch.
 - e. Standard switch or IS may control an individual, sub-group or group of EDU's in accordance with the address in each EDU.

2.3 SHADE BANDS

- A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
 - 1. Concealed Hembar: Shall be continuous extruded aluminum for entire width of shade band and with the following characteristics:
 - a. Hembar shall be heat sealed on all sides.
 - b. Open ends shall not be accepted.
 - 2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection.
 - b. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.

- c. Mounting Spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
- d. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

2.4 ROLLER SHADE FABRICATION

- A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.
- B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

2.5 ROLLER SHADE COMPONENTS

- A. Access and Material Requirements:
 - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 - 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
 - 3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.
- B. Motorized Shade Hardware and Shade Brackets:
 - 1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade. Plastic components without use of steel angle construction do not meet the intent of this specification and shall not be accepted.
 - 2. Provide shade hardware system that allows for field adjustment of EDU or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
 - 3. All bands within a single EDU group shall be aligned within 1/4 inch (6 mm).

2.6 ROLLER SHADE SCHEDULE

- A. Roller Shade Schedule: Refer to the Drawings for locations.
 - 1. Shade Type 1: Motorized sunscreen roller shades in exterior windows of rooms and spaces shown on the Drawings, and related EDU control requirement systems.
 - a. Shade pockets.

- b. Fascias.
- c. Shadecloth.
- d. Location: All exterior windows unless noted otherwise.

2.7 SHADECLOTH

- A. Visually Transparent Single-Fabric Shadecloth: MechoSystems, EuroVeil® “5300” or EuroTwill® “6000” Series: 0.010 diameter (0.254 mm), Opaque, non-raveling vinyl/polyester yarn, fabric thickness 0.025 inches (0.635 mm).
 - 1. Extra Dense Twill Weave “6000” series, 2-3 percent open.
 - 2. Color: 6009 Dove Gray

2.8 ROLLER SHADE ACCESSORIES

- A. Shade Pocket: For recessed mounting in acoustical tile or drywall ceilings as indicated on the drawings.
 - 1. Either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
- B. Fascia:
 - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 2. Fascia shall be able to be installed across two or more shade bands in one piece.
 - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 TURN-KEY SINGLE-SOURCE RESPONSIBILITY FOR INTERIOR ROLLER SHADES:

To control the responsibility for performance of the electric roller shade system; assign the design, engineering, and installation of electronic drive roller shade control system, shades, addressable controls, communication interfaces, and any required sensors, switches and low voltage control wiring specified in this Section to the manufacturer of the shade and control system.

- A. General Contractor Responsibilities:

1. Provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings and manufacturer's shop drawings.
 2. Coordinate with requirements of subcontractor for this section before inaccessible areas are constructed.
 3. Coordinate requirements of ALSCS before inaccessible areas are constructed.
 4. Provide conduit with pull wire in all areas, which might not be accessible to ALSCS due to building design, equipment location or schedule:
 5. Coordinate with the main building electrical subcontractor to provide duplex 120 VAC power receptacle in Electric closet for floor/riser Communication Gateways.
 6. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
 7. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
 8. Protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.
 9. Be responsible for all other required electrical work including but not limited to roof penetrations, conduits, fireproofing, etc.
 10. Provide conduit with pull wire in all areas, which might not be accessible to subcontractor due to building design, equipment location or schedule.
- B. Window Covering Subcontractor (WC) Responsibilities:
1. Shade Control Subcontractor shall furnish and install shade controllers, interfaces, splitters, coupler, sensors, switches, junction boxes, etc mounted in the ceiling in an accessible location. Locations for all visible devices to be coordinated with Architect. The shade control subcontractor shall inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.
 2. Line Voltage Wiring:
 - a. WC to ROLLER SHADE EDU: The WC shall furnish and install power connection between Shade control system and EDU, and shall be capable of providing single line voltage wire pull for each EDU.
- C. Shade Power Wiring (WC)
1. Shall furnish and install line voltage Cable from roller shade motor into line voltage side of control system.
 2. Shall wire from General Contractor, provided, power junction box to each motor on the shade network.
 3. Shall furnish and install a disconnect plug at the end of the power wiring run to each EDU. The disconnect plug must mate with a matching disconnect plug on the motor cable. EDU cable disconnect plug must be prefabricated by the manufacturer to meet UL and ETL systems requirements.

3.4 INSTALLATION OF ROLLER SHADES

- A. Contractor Furnish and Install Responsibilities:
1. Window Covering Contractor (WC) shall provide an on site, Project Manager, and shall be present for all related jobsite scheduling meetings.

2. WC shall supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25 inches (6.35mm).
3. WC shall be responsible for field inspection on an area-by- area and floor-by-floor basis during construction to confirm proper mounting conditions per approved shop drawings.
4. Verification of Conditions: examine the areas to receive the work and the conditions under which the work would be performed and notify General Contractor and Owner of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of installation shall constitute acceptance of substrate conditions by the installer.
5. WC shall provide accurate to 0.0625 inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
6. WC Installer shall install roller shades level, plumb, square, and true according to manufacturer's written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect's design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625 inch (15.875mm) over 20 linear feet (6.096 meters)
7. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
8. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
9. Installer shall set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
10. WC shall certify the operation of all motorized shades and turn over each floor for preliminary acceptance.
11. The WC shall participate and cooperate with the electrical contractor, the window shade manufacturer and the Commissioning agent to verify and certify the installation is in full conformance with the specifications and is fully operational. This work to occur during the commissioning stage and is in addition to preliminary acceptance required for each floor.
12. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
13. WC shall train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.
14. Protect installed products until completion of project.
15. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 122124

SECTION 142400 - MACHINE ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified.
Elevator work includes:
1. Standard pre-engineered hydraulic passenger elevators.
 2. Elevator car enclosures, hoistway entrances and signal equipment.
 3. Operation and control systems.
 4. Jack(s).
 5. Accessibility provisions for physically disabled persons.
 6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
 7. Materials and accessories as required to complete the elevator installation.
- B. Related Sections:
1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
 2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
 3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
 4. Division 5 Metals:
 - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
 - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
 5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
 6. Division 26 Sections:
 - a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
 - b. Emergency power supply, transfer switch and auxiliary contacts.
 - c. Heat and smoke sensing devices.
 - d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
 7. Division 22 Plumbing
 - a. Sump pit and oil interceptor.
 8. Division 23 Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.
- C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.

2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. All wire and conduit should run remote from the hoistways.
10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
11. Install and furnish finished flooring in elevator cab.
12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
17. General Contractor shall fill and grout around entrances, as required.
18. All walls and sill supports must be plumb where openings occur.
19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
22. For signal systems and power operated door: provide ground and branch wiring circuits.
23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.

24. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

- A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings:
 1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 4. Indicate electrical power requirements and branch circuit protection device recommendations.
- C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- E. Metal Finishes: Upon request, standard metal samples provided.
- F. Operation and maintenance data. Include the following:
 1. Owner's manuals and wiring diagrams.
 2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
 1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
 2. The manufacturer shall have a documented, on-going quality assurance program.
 3. ISO-9001:2000 Manufacturer Certified
 4. ISO-14001:2004 Environmental Management System Certified
 5. LEED Gold certified elevator manufacturing facility.

- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- C. Regulatory Requirements:
 - 1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
 - 2. Building Code: National.
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Windows.
 - 5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
 - 6. Section 407 in ICC A117.1, when required by local authorities.
- D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- E. Inspection and testing:
 - 1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
 - 2. Arrange for inspections and make required tests.
 - 3. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

- A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
 - 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work,

- including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
 3. Manufacturer shall have a service office and full-time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Design based around TK Elevator's endura Machine Room-Less hydraulic elevator.
- B. Additional Manufacturers:
 1. Otis
 2. Shindler
 3. If the Contractor selects a manufacturer and product that is not the basis of design, it will be the Contractor's responsibility to identify all variations and required changes that differ from the construction documents and basis of design product. Contractor shall coordinate and account for all changes, including but not limited to; electrical power, shaft dimensions, pit, communications systems, structural loads, etc.

2.02 MATERIALS, GENERAL

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1-2010, CA Section 01350 as mentioned in 1.03.9 of this specification.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
- C. Steel:
 1. Shapes and bars: Carbon.
 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture's standard selections.
- D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.
- E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
- D. Guides: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless. Two jacks piped together, mounted one on each side of the car with a polished steel hydraulic plunger housed in a sealed steel casing having sufficient clearance space to allow for alignment during installation. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section..
- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)
- I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
- J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
 2. An oil hydraulic pump.
 3. An electric motor.
 4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.
- D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
 2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
 5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
 6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
 7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
 8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
 - 1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
 - 2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.
 - 3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.

- B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.

- C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3-phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details.

- D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

- E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
 - 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 - 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 - 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

- F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

- A. Car Enclosure:
 - 1. Walls: Cab type TKLP, durable wood core finished on both sides with high pressure plastic laminate.
 - 2. Canopy: Cold-rolled steel with hinged exit.
 - 3. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
 - 4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
 - 5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
 - a. Door Finish: Stainless steel panels: No. 4 brushed finish.

- b. Cab Sills: Extruded aluminum, mill finish.
 - 6. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
 - 7. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

- A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
- 1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 - 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 - 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
 - 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
 - 5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 - 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided.
- C. Auxiliary Operating Panel:
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- E. Digital Services: Cloud-based IoT monitoring system comes standard with these options:

A17.1 2019 Code - Enhanced Communications

2.09 CONTROL SYSTEMS

- A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
1. Access to main control board and CPU

2. Main controller diagnostics
 3. Main controller fuses
 4. Universal Interface Tool (UIT)
 5. Remote valve adjustment
 6. Electronic motor starter adjustment and diagnostics
 7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
 8. Operation of auxiliary pump/motor (secondary hydraulic power source)
 9. Operation of electrical assisted manual lowering
 10. Provide male plug to supply 110VAC into the controller
 11. Run/Stop button
- C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- D. Emergency Power Operation: (10-DOA) Upon loss of the normal power supply, building-supplied standby power is available on the same wires as the normal power supply. Once the loss of normal power is detected and standby power is available, the elevator is lowered to a pre-designated landing and the doors are opened. After passengers have exited the elevator, the doors are closed and the car is shut down. When normal power is restored, the elevator automatically resumes operation.
- E. Digital Services:

Cloud-based IoT Monitoring System (standard): Contractor shall provide a cloud-based IoT (internet of things) monitoring system capable of tracking door movements and timing, trips, power cycles, car calls, out-of-service events and modes. This observation will continue 24/7 and it shall be capable of providing service technicians a minimum of three recommended solutions for defined failure events and automatically dispatch service technicians in the event of failure(s) while sending notifications to end users of changes in their equipment's state via both email and mobile device. Access to IoT and related equipment data and status will be made available in both a web portal and mobile application secured by password and username with at least two-factor authentication. Finally, this system must be self-contained and not require internet provision by others.

A17.1 2019 Code – Enhanced Communications: For jobs installed under enforcement of 2018 International Building Code or ASME A17.1-2019/CSA B44:19 Safety Code, contractor will provide a video camera necessary for viewing the elevator cab interior floor as well as a position indicator display in the cab operating panel capable of providing means of two-way, text-based communication when the emergency call button is engaged in the elevator car. These components, and associated cloud-based monitoring platform, will be non-proprietary in nature, allowing customization on where to direct emergency calls, while offering capability for any party to provide the emergency monitoring services.

2.10 HALL STATIONS

- A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
 - 1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
 - a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.
- B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.
- C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
 - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
 - 1. Elevator Model: endura MRL Twinpost above-ground 1-stage
 - 2. Elevator Type: Hydraulic Machine Room-Less, Passenger
 - 3. Rated Capacity: 3500 lbs.
 - 4. Rated Speed: 110 ft./min.
 - 5. Operation System: TAC32H
 - 6. Travel: 32'-0"
 - 7. Landings: 4 total
 - 8. Openings:
 - a. Front: 1
 - b. Rear: 1
 - 9. Clear Car Inside: 6'-8" wide x 5'-5 1/2" deep
 - 10. Inside clear height: 7'-4" standard
 - 11. Door clear height: 7'-0" standard
 - 12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high

13. Door Type: One-speed | LH Side opening
14. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
15. Seismic Requirements: As indicated in Drawings.
16. Hoistway Dimensions: 8'-4" wide x 7'-10 3/4" deep
17. Pit Depth: 4'-0"
18. Button & Fixture Style: Traditional Signal Fixtures
19. Digital Services:
 - A17.1 2019 Code - Enhanced Communications

END OF SECTION 142400

SECTION 210110 – FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.
- B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate, and advise those sub-contractors all the requirements, conditions, and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

- A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.
 - 1. International Fire Code.
 - 2. NFPA Documents.

1.3 SCOPE OF WORK:

- A. Provide all labor, materials, equipment, and supervision to construct complete and operable fire protection systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged, and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

- A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.
- B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.
- C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a

manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

- A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply, and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

- A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Design Professional at least 10 days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

- A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.
- B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.
- C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.
- D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.
- E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

- A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shutdown of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.
- B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage, and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.
- C. Permits and Tests: Provide labor, material, and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or authorized representative. Notify the Design Professional five days in advance of any testing.

END OF SECTION 210110

SECTION 210120 – FIRE PROTECTION STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Industry Standards: It is a general requirement that fire protection work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations. Listing of Associations, Standards, and Abbreviations:

- | | |
|----------|--|
| 1. AWS | American Welding Society, Inc.
2501 NW 7th St., Miami, FL 33125 |
| 2. CISPI | Cast Iron Soil Pipe Institute
2020 K. St., NW, Washington, DC |
| 3. NEC | National Electrical Code by NFPA |
| 4. NEMA | National Electrical Manufacturers Association
1300 N 17 th Street, Suite 1847
Rosslyn, VA 22209 |
| 5. NFPA | National Fire Protection Association
407 Atlantic Ave.,
Boston, MA 02210 |
| 6. UL | Underwriters' Laboratories, Inc.
207 East Ohio St.,
Chicago, IL 60611 |

PARTS 2 AND 3 - PRODUCTS AND EXECUTION (Not applicable)

END OF SECTION 210120

SECTION 210210 – FIRE PROTECTION COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordinate the actual location of all fire protection work visible in finished spaces with the Design Professional.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

- A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power-driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Design Professional prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The fire protection contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.
- B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.
- C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors, and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be *UL listed* and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

- A. Substrate Examination: The Installer of each element of the work must examine the

condition of the substrate to receive the work, and the conditions under which the work will be performed and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

- B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

- A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Design Professional's written authorization. Authorization will be granted only where there is not another reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.
- B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.
- C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut and comply with recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.
- D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of fire protection work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Design Professional. Engage the original Installer to complete patching of the following categories of work:
 - 1. Exposed concrete finishes.
 - 2. Exposed masonry.
 - 3. Waterproofing and vapor barriers.
 - 4. Roofing, flashing and accessories.
 - 5. Interior exposed finishes and casework, where judged by the Design Professional to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF FIRE PROTECTION INSTALLATION:

- A. General: Sequence, coordinate and integrate the various elements of fire protection work so that building systems will perform as indicated and be in harmony with other work of the building. The Design Professional will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:
 - 1. Install piping and similar services straight and true, aligned with other work and with

- overhead structures and allowing for insulation where applicable. Conceal where possible.
2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
 3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
 4. Store materials off the ground and protected from standing water and weather.
- B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Design Professional's decision on resolution of the conflict.
- C. Electrical Work: Coordinate the fire protection work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install fire protection equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of fire protection equipment.
- D. Utility Connections: Coordinate the connection of fire protection systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 210210

SECTION 210220 – FIRE PROTECTION SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

- A. The purpose of submittals is to demonstrate to the Design Professional that the Contractor understands the design concept. The Design Professional's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Design Professional's attention to such deviations at the time of submission, and has received from the Design Professional, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.
- B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged, and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 21 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.
- C. Electronic Submittals: All electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 21 Superintendent's name, Suppliers and point of contact for each, and date.
- D. Submittals shall be made for all items contained in the following specification sections:
 - 1. Fire Protection Coordination
 - 2. Fire Protection Identification
 - 3. Fire Protection Pipe, Tube, and Fittings
 - 4. Fire Protection Hangers and Supports
 - 5. Fire Protection Seismic Control
 - 6. Fire Protection Sprinkler System
 - 7. Fire Pump
 - 8. Fire Pump Controller
 - 9. Jockey Pump
 - 10. Jockey Pump Controller
 - 11. Hydraulic Calculations

- E. Response to Submittals: A Submittal Review Report shall be issued by the Design Professional with the following classifications for each item:
1. **"No Exceptions Taken"**: No corrections, no marks. Contractor shall submit copies for distribution.
 2. **"Make Corrections Noted"**: A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
 3. **"Revise and Resubmit"**: Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
 4. **"Rejected"**: Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

- A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.
- B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections and show interface with other work including structural support. Indicate by note, the portions of fire protection work shown on the shop drawings which deviated from the indication of work in the contract documents and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.
- C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.
- D. Certifications: Where specifically indicated, submit with notarized execution.
- E. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

- F. **Manufacturer's Product Warranties:** Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Design Professional), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

- A. **Operating Instructions:** Submit manufacturer's operating instructions for each item of fire protection equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase, or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language.
- B. **Maintenance Manuals:** Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
1. System operating instructions.
 2. Emergency instructions including addresses and telephone numbers of service sources.
 3. Regular system maintenance procedures including lubrication.
 4. Spare parts listing and stocking recommendations.
 5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
 6. Valve schedule and control diagram for each system.
 7. Manufacturer's data for each operating item in each system.
 8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
 9. Corrected or approved issues of submittal items relating to the system.
 10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.
- C. **Maintenance Materials:** Deliver to Owner's representative at the location as directed, in containers or packages suitable for storage and fully identified.
- D. **Guarantees:** Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

END OF SECTION 210220

SECTION 210230– FIRE PROTECTION IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.
- B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6", provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe.
 - d. Taped to pipe with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
3. Large Pipes: For external diameters of 6 inches and larger, provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe.
 - b. Taped to pipe with color-coded plastic adhesive tape, not less than 1-1/2" wide: full circle at both ends of pipe marker, tape lapped 3".
4. Lettering: Comply with piping system names as specified, scheduled, or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on piping of the following piping systems:
 - a. Automatic Wet Pipe Sprinkler System Water

- b. Automatic Dry Pipe Sprinkler System Water
 - c. Fire Standpipe System Water
 - d. Clean-Agent Fire Suppression System Piping
- B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- 1. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters of less than 6", 2-1/2" wide tape on larger pipes.
 - 2. Color: Comply with ANSI A13.1.
- C. Engraved Plastic-Laminate Signs:
- 1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 - 2. Thickness: 1/16", except as otherwise indicated.
 - 3. Fasteners: Self-tapping stainless-steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Valve Tags:
- 1. Valve signs shall be in accordance with NFPA 13.
 - 2. The identification sign shall be secured with corrosion-resistant wire, chain, or other approved means.
 - 3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall with NFPA and UL.
- E. Valve Charts:
- 1. Valve charts shall be provided for fire protection systems. Charts shall be located at the riser.
 - 2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified, or scheduled. Provide numbers and lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the systems and equipment.
- B. Multiple Systems: Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

- A. Coordination: Where identification is to be applied to surfaces which require painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.
- B. Piping System Identification: Install pipe markers on each system indicated to receive identification and include arrows to show normal direction of flow.
- C. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
 - 3. Near locations where pipes pass through walls or ceilings or enter non-accessible enclosures.
 - 4. Near major equipment items and other points of origination and termination.
 - 5. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
- D. Do not mark piping exposed in finished occupied spaces.
- E. Fire protection Equipment Identification: Install an engraved plastic laminate sign on or near each major item of fire protection equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of fire protection equipment.
- F. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 210230

SECTION 210240 – FIRE PROTECTION WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DOCUMENTATION PROCEDURES:

- A. Signed Commitments: Do not proceed with transfer of fire protection systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Design Professional (for Owner's records).

1.3 RECORD DRAWINGS:

- A. Explanation: Except where otherwise indicated, fire protection drawings (contract drawings) prepared by Design Professional are diagrammatic in nature and may not show locations accurately for various components of fire protection systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.
- B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of fire protection contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of fire protection work which previously is either not shown or shown inaccurately, but in any case, record the following:
 - 1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
 - 2. Fire Protection "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

- A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.
- B. System Performance Test Run: At the time of fire protection work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Design Professional present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Design Professional's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Design Professional's final inspection of the fire protection work.
- C. Cleaning and Lubrication: After final performance test run of each fire protection system, clean system. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as fire protection work; refinish work where damage is extensive.
- D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual fire protection sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the fire protection systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.
 - 1. Describe each basic system and how its control system functions.
 - 2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
 - 3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shutdown.
 - 4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
 - 5. Outline basic maintenance procedures.
- E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.
- F. Point out operational security provisions, safety, unavoidable hazards, and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.
- G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction

equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

- A. Final Acceptance: At time of substantial completion of fire protection work, Owner's operating personnel will take over operation of fire protection systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 210240

SECTION 210310 – FIRE PROTECTION EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordination: Where excavation and backfill for fire protection work passes through or occurs in the same areas as work specified in the Division 02 sections, comply with both the requirements of the Division 02 sections and the requirements of this section, whichever is the more stringent (as determined by the Design Professional in cases of conflicting requirements).

1.3 JOB CONDITIONS:

- A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

- A. Subbase Material: A graded mixture of gravel, sand, crushed stone, or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

- A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations, and barricades as necessary to prevent accidents at

- excavations.
3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
 4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves, and other work. Provide a minimum of 12" clearance around underground tanks.
 5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
 - a. Piping of 5" and less pipe/tube size.
 - b. Cast-in-place concrete.
 6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
 7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
 8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
 - a. Retain excavated material which complies with the requirements for backfill material.
 - b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

- A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment, or erosion from or through excavations.

3.3 BASE PREPARATION:

- A. Install subbase material to receive fire protection work and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.
- B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves, and similar enlargements in the piping systems.

3.4 BACKFILLING:

- A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.
- B. Condition backfill material by either drying or adding water uniformly, to whatever extent

may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

- C. Backfill simultaneously on opposite sides of work and compact simultaneously; do not dislocate the work from installed positions.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
 - 1. Lawn/Landscaped Areas: 90%
 - 2. Roadways: 95%
 - 3. Paved Area, Other than Roadways: 95%
- E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
- F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Design Professional.

3.5 PERFORMANCE AND MAINTENANCE:

- A. Where subsidence is measurable or observable at fire protection work excavations during the guarantee period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 210310

SECTION 212010 - FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE:

- A. Fire Protection Supply Pipe: Route the building fire main to the municipal water main and connect to the supply line at the appropriate time and location. Contractor shall field verify exact location of water main prior to start of construction.
- B. Work Includes but is not limited to:
 - 1. Installing a complete "Wet Pipe" Automatic Sprinkler system throughout the building.
 - 2. Install a complete fire pump system.
- C. Related Work Specified Elsewhere: Wiring of flow alarm switches and tamper switches and connection of switches to building alarm system are specified in Section 271010.
- D. Sprinkler Design Requirements: (for Ordinary Group 2 Hazard)
 - 1. The sprinkler system shall be a wet pipe type. The design area shall be the most remote 1500 square feet. The design density shall be .20 gpm/ft². Hose requirement shall be 250 gpm.
 - 2. The contractor shall submit 4 complete sets of sprinkler shop drawings and hydraulic calculations to the Design Professional for review, prior to ordering material and/or cutting pipe. Contractor shall not cut any piping until shop drawings have been reviewed and accepted. The contractor shall show in dashed lines the location of all ductwork, lights, and diffusers.
 - 3. The contractor shall be responsible for coordinating sprinkler piping and head locations with other trades. Contractor shall relocate sprinkler piping and heads as necessary to avoid conflict with ductwork, lights, and structure.
 - 4. Provide auxiliary drains at low points in system and for trapped sections as required by NFPA-13. Locate auxiliary drains in mechanical closets or other locations out of sight.
 - 5. The contractor shall include a (10 psi) buffer in the hydraulic calculations, i.e. the pressure required for the sprinkler system (including hose stream) shall be a minimum of 10 psi less than the available pressure at the required flow.
 - 6. The contractor shall perform a flow test prior to commencing design and shall provide test information to the Design Professional for approval. Sprinkler system design shall be based upon the contractor's flow test.

1.3 QUALITY CRITERIA:

- A. Permits, Licenses, Inspection Fees:
 - 1. Obtain and pay for permits, licenses and inspection fees as may be required for performance and approval of the work performed under this section of the specifications.
 - 2. Comply with all requirements of *NFPA 13*, *NFPA 20*, *NFPA 24* and the State Fire Marshall and local codes.
- B. Materials: Materials specified by manufacturer's name shall be used unless prior approval of a substitute is given by addenda.

1.4 SUBMITTALS:

- A. Before materials and equipment are purchased, submit for Design Professional's approval, a complete schedule of materials and equipment to be incorporated in the work. Submittals shall include the following:
 - 1. Complete Shop Drawings with hydraulic calculations
 - 2. Fire Pump and Accessories
 - 3. Jockey Pump and Accessories
 - 4. All Valves
 - 5. Fire Department Connections
 - 6. Sprinkler Heads
 - 7. Tamper Switches
 - 8. Pipe Hangers and Supports
 - 9. Pipe and Fittings
 - 10. Cabinets
 - 11. Access Panels
 - 12. Alarm Valve
- B. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable style number.
- C. Sprinkler heads shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.5 TESTING PIPE SYSTEMS:

- A. Tests shall be conducted in the presence of the Design Professional or his designated representative. Equipment, materials, and instruments for testing shall be furnished by the Contractor without additional cost to the Owner.
- B. Automatic Sprinkler Piping: The automatic sprinkler systems shall be hydrostatically tested in their entirety or in zones defined by shutoff valves. The piping shall be tested at a pressure of 200 psig, measured at the low point in the system or zone, and shall be proved tight at this pressure for a period of not less than (2) hours. Leaks detected shall be repaired by tightening, rewelding joints, or replacing damaged pipe or fittings. Caulking of joints will not be permitted.

1.6 OPERATION AND MAINTENANCE INSTRUCTIONS:

- A. Operating and Maintenance Instructions, printed and bound in hard cover three ring loose leaf notebooks, shall be provided for each item of equipment listed below; 5 separate copies shall be provided. Each notebook shall be provided within an identifying label under a clear plastic cover shield on the front cover which shall identify the Project, Design Professional, Contractor, and Date.
1. National Fire Protection Association Pamphlet No. 25.
 2. Copies of All Approved Submittal Data (listed above under submittals).
 3. As-Built copies of Design Drawings and Hydraulic Calculations.

1.7 GUARANTEE:

- A. All equipment shall be guaranteed as specified under the General and Special Conditions. Guarantee on all equipment shall start and coincide with the Contractor's guarantee obligations.

PART 2 - PRODUCTS AND INSTALLATION

2.1 PIPE AND FITTINGS:

- A. Pipe and fittings listed herein shall be for the services indicated.

2.2 SPRINKLER AND STANDPIPE:

- A. Piping Options:
1. Schedule 40 black steel pipe: ASTM A-795, A-53, or A-135 with class 150- or 300-pound malleable iron threaded fittings, welded steel fittings, or with mechanical grooved joint couplings. Mechanical couplings for main sprinkler and standpipe risers shall be rigid type coupling.
 2. Schedule 10 black steel pipe: ASTM A-135 pipe, UL listed for sprinkler systems. Fittings for thin wall pipe shall be same type specified for Schedule 40 pipe.

2.3 JOINTS:

- A. Mechanical grooved joint couplings shall be listed for use in fire protection systems.
1. Grooved End Fittings: Fittings shall be ductile iron (ASTM A536); forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
 2. Mechanical Couplings: Coupling housings shall be ductile iron (ASTM A536). Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 to +230 F. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings

with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used.

- a. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA 13.
 - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.
- B. Welded flanged joints shall be faced true, provided with 1/16" ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges or valves. Welding shall comply with ANSI B31.1.
- C. Welded joints shall be butt welded in accordance with ANSI B31.1.
- D. Qualification of Welders:
1. All welders employed for the work shall be qualified under the requirements of *ANSI B31.1.0, Section 127.5*.
 2. Evidence of the welder's qualifications shall be submitted to the Design Professional before any welds are made.
 3. Coupling for sprinkler piping shall be *Victaulic Model 75*.
- E. Underground Pipe:
1. Standard weight ductile iron pipe with mechanical "bolted type" joints.
 2. Provide tie rods and thrust blocks at each change of direction of the underground fire service piping. Install tie rods and thrust blocks in accordance with *NFPA 24* requirements.

2.4 FIRE DEPARTMENT VALVES:

A. Valves:

1. Valves of the same type shall have the name or trademark of the manufacturers and the working pressure stamped or cast on the valve body.
2. All valves installed in horizontal lines shall be installed with the stems horizontal or above. Valve handwheels shall be oriented, when installed, to provide maximum accessibility for operation.
3. All valves requiring packing shall be designed and constructed such that they can be repacked under pressure.
4. Valve handwheels shall be malleable iron.
5. Fire Department Valves: Fire department angle valves shall be 2-1/2" size pressure reducing type complete with cap and chain. Valves shall have polished brass finish and shall be *Elkhart UP-25, Potter-Roemer 4085 or equivalent by Nibco or Sierra*.

2.5 VALVES, EQUIPMENT AND ACCESSORIES FOR FIRE PROTECTION SYSTEM:

- A. Gate Valves 2-1/2" and Larger: Valves shall be O.S. and Y type with iron body, bronze trim, solid wedge, and flanged ends for 175-pound W.W.P. Valves shall be UL listed with identification mark for such stamped or cast on valve body. Valve shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- B. Gate Valves 2" and Smaller: Valves shall be O.S. and Y type with bronze body, solid wedge, and threaded ends for 175-pound W.W.P. Valves shall be UL listed with identification mark for such stamped or cast on valve body. Valves shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- C. Check Valves 2" in Size and Smaller: Check valves shall be horizontal swing type with bronze body, composition disc, threaded ends for 200-pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- D. Swing Check Valves 2-1/2" and Larger: Check valves shall be horizontal swing type with iron body, bronze trim, and flanged ends for 175-pound W.W.P. Valves shall be UL listed with identification mark for such stamped or cast on the valve body. Valves shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- E. Wafer Check Valves 4" and Larger: Valves shall be iron body with bronze trim, EPDM O-ring seals and stainless steel Hinge pins. Valve shall be UL listed and FM approved. Wafer check valves shall be Grinnell, Victaulic, or Gruvlock.
- F. Spring-Assisted Check Valves 2-1/2" and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body with aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft and grooved ends. Spring-assisted check valves shall be Victaulic, or Gruvlock.
- G. Butterfly Valves 2-1/2" and Larger: Valve shall be UL listed and FM approved. Valves shall have a ductile iron body, elastomer encapsulated ductile iron disc with integrally cast stem and grooved ends. Butterfly valves shall be Victaulic, Gruvlock, or Kennedy.
- H. Globe Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200-pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- I. Angle Valves: Valves shall have bronze body, rising stem, composition disc, threaded ends for 200-pound W.O.G. and shall be Crane, Stockham, Nibco/Scott, or Kennedy.
- J. Post Indicator Valve: Shall consist of a Mueller A-2052 N.R.S. Gate Valve and a Mueller A-20800 adjustable indicator post, or equivalent by Kennedy or Nibco.
- K. Sprinkler Wet Pipe Alarm Valves: Valves shall be UL listed and shall be furnished with all standard trim including pressure gauges, by-pass, test valves, electric alarm pressure switch and main drain. Valve shall be cast iron or ductile iron, and all parts in contact with water shall be non-ferrous. Internal parts shall be replaceable without removal of valve from installed position. Valve shall be Victaulic, Central Sprinkler, Viking, Grinnell, Automatic Sprinkler, or Reliant.
- L. Electric alarm pressure switches shall be dual switch closer or opener type, and shall be *System Sensor, United Electric, Potter, or Viking*.

- M. Supervisory Switches: The valve for each sprinkler system shall be provided with a valve mounted switch capable of detecting motion of the valve from a full open position. Switches shall be UL listed and FM approved. Switch shall be *System Sensor, United Electrics, Potter, or Viking*.
- N. Water Flow Switches: water flow switches shall be line mounted vane type with retard. Switch shall consist of two single pole, double throw, snap action switches and an adjustable, recycling pneumatic retard, contained inside a general-purpose die-cast housing. Switches shall be capable of either horizontal or vertical mounting and shall be UL listed and FM approved. Switch shall be *System Sensor, United Electrics, Potter, or Viking*.
- O. Electric Bell: Bell shall be 10" round red enameled steel bell 120-Volt A.C. electric motor. Bell shall be *Potter, Viking, System Sensor, or United Electrics*.
- P. In-Building Riser: In-Building Riser shall be installed as indicated on the plans. Riser shall be composed of a single extended 90-degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged-end or grooved-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. In-Building Riser shall be *Ames Fire & Waterworks, Zurn, or Viking*.
- Q. Riser Manifold Assembly: shall be UL listed for horizontal or vertical installation as a one-piece, fabricated assembled unit. The riser manifold assembly shall consist of a cast, non-welded, ductile iron body with grooved end connections having all brass and galvanized trim. The manifold piping shall clearly identify manifold pipe size, flow direction, test, drain, and gauge outlets. A built-in drain port shall be available to permit hydrostatic testing without draining the system. Assembly shall have a working pressure rating of 300 psi.

2.6 SPRINKLER HEADS:

- A. Sprinkler heads shall be glass-bulb type. Body shall be die cast brass, with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.
- B. Sprinkler head types shall be coordinated with the Design Professional.
- C. Upright sprinkler heads shall be ½ inch spray type with bronze finish. Sprinklers shall be *Viking, Reliable, Tyco, or Automatic Sprinkler*.
- D. Pendent sprinkler heads unless otherwise indicated pendent sprinkler heads shall be quick response 1/2" spray type with chrome plated finish and white escutcheon plate. Sprinklers shall be *Viking, Reliable, Tyco, or Automatic Sprinkler*.
- E. Dry Pendent sprinkler heads shall be 1/2" recessed type with polished brass finish. Sprinklers shall be *Viking, Reliable, Tyco, or Automatic Sprinkler*.
- F. Sidewall sprinkler heads shall be quick response 1/2" spray type with chrome plated finish and white escutcheon. Sprinklers shall be *Viking, Reliable, Tyco, or Automatic Sprinkler*.
- G. Concealed pendent sprinkler heads shall be 1/2" spray type with chrome plated finish and white escutcheon and ceiling plate. Sprinklers shall be *Viking, Reliable, Tyco, or Automatic*

Sprinkler.

2.7 FLEXIBLE SPRINKLER CONNECTIONS:

- A. Flexible sprinkler connections may be used to locate sprinklers as required by final finished ceiling tiles and walls. The flexible sprinkler connection system shall consist of a braided type 304 stainless steel flexible hose, zinc plated steel male threaded nipple or groove style coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head. System shall be FM 1637 and UL 2443 approved and designed for use in hydraulically calculated wet, preaction, deluge or dry sprinkler systems per NFPA 13 and UL2443 requirements. Hose assembly shall be UL listed for a maximum working pressure of 175 psi or FM approved for a maximum working pressure of 200 psi, maximum working temperature of 300°F, and minimum allowable bending radius of 3" per UL guidelines and 7" per FM guidelines. Flexible sprinkler connection systems shall be by *Anvil, Viking, Reliable, or Victaulic*.
- B. Provide with the flexible sprinkler connection system manufacturer's reducer and bracket accessories as required for a complete installation.

2.8 HANGERS FOR FIRE PROTECTION PIPING:

- A. Hanger for 4" and larger horizontal lines shall be Clevis type hangers, B-Line, Anvil, or Erico.
- B. Hanger for horizontal lines up to 3½" shall be band type hangers, B-Line, Anvil, or Erico.
- C. Supports for vertical lines passing through floor shall be riser clamp type, Fee & Mason, Carpenter and Patterson, B-Line, Anvil, or Erico.

2.9 FIRE DEPARTMENT CONNECTION:

- A. The fire department connection shall be a Two-way wall mounted type with clappers, caps and chains, and identification base plate. Finish shall be polished brass. Fire department connections shall be *Potter Roemer, Elkhart, or Sierra*. Fire department connections shall be 5" locking *Storz* type.

2.10 FIRE PUMP AND ACCESSORIES:

- A. The pump shall be an electric driven type. The pump shall be selected by the fire sprinkler contractor and based on providing flow to meet the automatic sprinkler demand and pressure requirements. The pump shall meet the requirements of Underwriters' Laboratories, Factory Mutual and *NFPA 20*. The pump shall be furnished complete with all necessary accessories including but not limited to a controller, jockey pump, jockey pump controller, 2-1/2" test hose valves with caps and chains, hose valve header, suction and discharge gauges, casing relief valve, main relief valve, automatic air release valve, ball drip valve, and gate valves, and check valves.

- B. Fire pump frame shall be provided with vibration isolation.
- C. The pump manufacturer shall provide the services of a factory trained technician for check-out and startup of the fire pump systems.
- D. Fire pump and accessories shall be by *Patterson, A-C, Armstrong, or Aurora*.
- E. The pump manufacturer shall provide the services of a factory trained technician for check-out and start-up of the fire pump systems.

2.11 FREEZE PROTECTION:

- A. Aboveground wet pipes in unheated areas such as the fire service line serving the dry pipe valve shall be protected from freezing by tracing with self-regulating, heat trace tape. Heat trace tape shall be spiral wrapped as indicated on the drawings. Pipes shall then be insulated with 1" thick fiberglass insulation with all-service jacket (ASJ). Insulation exposed to weather shall be protected with an aluminum jacket weather sealed.
- B. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self-sealing ASJ facing conforming to ASTM C 547. Valves and fittings shall be insulated with fiberglass insulation of the same material thickness as insulation on adjacent pipe and having a molded PVC jacket. Jackets shall be Certainteed, Knauf, or Zeston.
- C. Aluminum Jacket: Corrugated, embossed or smooth sheet, 0.016" nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010. Provide stainless steel bands, minimum width of 1/2".

PART 3 - EXECUTION

3.1 GENERAL:

- A. Unless specifically stated otherwise, the fire protection system shall conform to all other sections of this specification which apply to pipe installation, accessories, and controls.
- B. All threaded hose outlets shall comply with the local fire department requirements.
- C. All shop drawings submitted on items requiring UL listing shall bear evidence of UL approval.
- D. All exposed fire system piping including valve room piping shall be cleaned of rust, grease and scaled and shall be provided with a field applied prime coat and two coats of an oil-based enamel paint. Color shall be red or as directed by Design Professional.
- E. The contractor shall perform all tests of Fire Protection Systems as required by governing codes and local authorities at no additional cost to the Owner. Tests shall be performed in the presence of the Owners representative.

3.2 INSTALLATION:

- A. Install sprinkler piping with a slope to valve room and to auxiliary low point drains as required by *NFPA 13*.
- B. Coordinate sprinkler installation with building structure and other trades.
- C. Route drains to outside building and terminate 9" AFG.
- D. Verify locations of lights and diffusers prior to installing sprinkler heads and piping.
- E. Sprinkler heads shall be installed on centerline with lights, diffusers, and doors, in living units. In lay-in tile ceiling the sprinkler heads shall be installed in the center of 2'x2' tiles and in the center of the half-tile in 2'x4' tiles.
- F. Contractor shall purge air from all wet pipe sprinkler system piping prior to final system completion.
- G. Provide return bends or flexible sprinkler head connectors in heated areas in order to allow for adjusting heads to centerline.
- H. Install a spare sprinkler cabinet near the sprinkler riser. Provide number of spare sprinklers as required by *NFPA 13*, with at least one spare for each type of head installed.
- I. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- J. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12" long by 180 degrees and shall be 18-gauge galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.

END OF SECTION 212010

SECTION 220110 – PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.
- B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate and advise those sub-contractors of the requirements, conditions, and information associated with providing and installing their portion of the total job.

1.2 IMPOSED REGULATIONS:

- A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for plumbing work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.
 - 1. International Plumbing Code.
 - 2. International Energy Conservation Code.
 - 3. International Fire Code.

1.3 SCOPE OF WORK:

- A. Provide all labor, materials, equipment, and supervision to construct complete and operable plumbing systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged, and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

- A. Damage to Existing Services: Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.
- B. Interruption of Services: Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.
- C. Removed Materials: Existing materials made unnecessary by the new installation shall be

removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 PRODUCT WARRANTIES:

- A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply and modified manufacturer's warranty shall be provided. In no case shall the manufacturer's warranty be less than one (1) year.

1.6 PRODUCT SUBSTITUTIONS:

- A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Design Professional at least (10) days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS:

- A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.
- B. Uniformity: Where multiple units of a general product are required for the work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.
- C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide adaptations as needed for interfacing of selected products in the work.
- D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.
- E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

- A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shutdown of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.
- B. Protection and Identification: Deliver products to project properly identified with names, models numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage, and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.
- C. Permits and Tests: Provide labor, material, and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or authorized representative. Notify the Design Professional five days in advance of any testing.

END OF SECTION 220110

SECTION 220120 - PLUMBING STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Industry Standards: It is a general requirement that plumbing work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations. Listing of Associations, Standards, and Abbreviations:

1. AGA
American Gas Association
1515 Wilson Blvd.
Arlington, VA 22209
2. ASHRAE
American Society of Heating, Refrigerating &
Air Conditioning Engineers, Inc.
1791 Tullie Circle, NE, Atlanta, GA. 30329
3. AWS
American Welding Society, Inc.
2501 NW 7th St., Miami, FL 33125
4. CISPI
Cast Iron Soil Pipe Institute
2020 K. St., NW, Washington, DC
5. NEC
National Electrical Code by NFPA
6. NEMA
National Electrical Manufacturers Association
1300 N 17th Street, Suite 1847
Rosslyn, VA 22209
7. NFPA
National Fire Protection Association
407 Atlantic Ave.,
Boston, MA 02210
8. UL
Underwriters' Laboratories, Inc.
207st Ohio St.,
Chicago, IL 60611

PART 2 AND 3 - PRODUCTS AND EXECUTION (Not applicable)

END OF SECTION 220120

SECTION 220210 - PLUMBING COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordinate the actual location of all plumbing work visible in finished spaces with the Design Professional.
- B. Plumbing Coordination Affidavit: Prior to ordering materials, provide the Coordination Affidavit required by Section 220220.

PART 2 - PRODUCTS

2.1 PRODUCT COORDINATION:

- A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power-driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Design Professional prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The plumbing contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.
- B. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.
- C. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors, and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the Authority having jurisdiction.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

- A. Substrate Examination: The Installer of each element of the work must examine the condition of the substrate to receive the work, and the conditions under which the work will be performed and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until coordination drawings have been processed and released for construction. Where work must be installed prior to that time, in order to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

- A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Design Professional's written authorization. Authorization will be granted only where there is not other reasonable method for completing the work, and where the proposed cutting clearly does not materially weaken the structure.
- B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.
- C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut and comply with recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.
- D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of plumbing work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Design Professional. Engage the original Installer to complete patching of the following categories of work:
 - 1. Exposed concrete finishes.
 - 2. Exposed masonry.
 - 3. Waterproofing and vapor barriers.
 - 4. Roofing, flashing and accessories.
 - 5. Interior exposed finishes and casework, where judged by the Design Professional to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF PLUMBING INSTALLATION:

- A. General: Sequence, coordinate and integrate the various elements of plumbing work so that building systems will perform as indicated and be in harmony with other work of the building. The Design Professional will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install piping and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation where applicable. Conceal where possible.
 2. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
 3. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
 4. Store materials off the ground and protected from standing water and weather.
- B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Design Professional's decision on resolution of the conflict.
- C. Electrical Work: Coordinate the plumbing work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install plumbing equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of plumbing equipment.
- D. Utility Connections: Coordinate the connection of plumbing systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

END OF SECTION 220210

SECTION 220220 - PLUMBING SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

- A. The purpose of submittals is to demonstrate to the Design Professional that the Contractor understands the design concept. The Design Professional's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Design Professional's attention to such deviations at the time of submission, and has received from the Design Professional, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.
- B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 22 Superintendent's name, Suppliers, and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.
- C. Electronic Submittals: All electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 22 Superintendent's name, Suppliers, and point of contact for each, and date.
- D. Submittals shall be made for all items contained in the following specification sections:
 - 1. Plumbing Coordination
 - 2. Plumbing Identification
 - 3. Plumbing Pipe, Tube, and Fittings
 - 4. Plumbing Hangers and Supports
 - 5. Plumbing Vibration and Seismic Control
 - 6. Plumbing Piping Systems Insulation
 - 7. Domestic Water Piping System
 - 8. Soil, Waste and Vent Piping System
 - 9. Water Heaters
 - 10. Plumbing Fixtures
 - 11. Electric Water Coolers

- E. Response to Submittals: A Submittal Review Report shall be issued by the Design Professional with the following classifications for each item:
1. **"No Exceptions Taken"**: No corrections, no marks. Contractor shall submit copies for distribution.
 2. **"Make Corrections Noted"**: A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
 3. **"Revise and Resubmit"**: Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
 4. **"Rejected"**: Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

- A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.
- B. Shop Drawings: Prepare shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections and show interface with other work including structural support. Indicate by note, the portions of plumbing work shown on the shop drawings which deviated from the indication of work in the contract documents and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.
- C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.
- D. Certifications: Where specifically indicated, submit with notarized execution.
- E. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.

- F. **Manufacturer's Product Warranties:** Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Design Professional or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 CLOSEOUT REQUIREMENTS:

- A. **Operating Instructions:** Submit manufacturer's operating instructions for each item of plumbing equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase, or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language.
- B. **Maintenance Manuals:** Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
1. System operating instructions.
 2. Emergency instructions including addresses and telephone numbers of service sources.
 3. Regular system maintenance procedures including lubrication.
 4. Spare parts listing and stocking recommendations.
 5. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
 6. Valve schedule and control diagram for each system.
 7. Manufacturer's data for each operating item in each system.
 8. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
 9. Corrected or approved issues of submittal items relating to the system.
 10. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.
- C. **Maintenance Materials:** Deliver to Owner's representative at the location as directed, in containers or packages suitable for storage and fully identified.
- D. **Guarantees:** Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal.

END OF SECTION 220220

SECTION 220230 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.
- B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 PLUMBING IDENTIFICATION MATERIALS:

A. Plastic Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible, or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6" (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe (or insulation).
 - d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
3. Large Pipes: For external diameters of 6" and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe (insulation).
 - b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide: full circle at both ends of pipe marker, tape lapped 3".
4. Lettering: Comply with piping system names as specified, scheduled, or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on piping of the following piping systems:
 - a. Domestic Cold Water

- b. Domestic Hot Water
 - c. Dom. Hot Water Return
- B. Plastic Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick:
- 1. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters including insulation of less than 6", and 2-1/2" wide tape on larger pipes.
 - 2. Color: Comply with ANSI A13.1.
- C. Engraved Plastic-Laminate Signs:
- 1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 - 2. Thickness: 1/16", except as otherwise indicated.
 - 3. Fasteners: Self-tapping stainless-steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Valve Tags:
- 1. Valve tags shall be 18-gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint
 - 2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
 - 3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall be as follows:

<u>Identification System</u>	<u>Shape</u>	<u>Numbers</u>
Domestic Cold Water	Square	CW-1, 2, 3, ...
Domestic Hot Water	Square	HW-1, 2, 3, ...
Dom. Hot Water Return	Square	HWR-1, 2, 3, ...

- E. Valve Charts:
- 1. Valve charts shall be provided for plumbing systems. Charts shall be located in the main mechanical room.
 - 2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, Water Heater WH-1, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in a wooden frame with glass cover.

2.2 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in the identification work, with the corresponding designations shown, specified, or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and

operation/maintenance of the systems and equipment.

- B. Multiple Systems: Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished spaces, install identification after completion of covering or painting.
- B. All equipment, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.
- C. Piping System Identification: Install pipe markers on each system indicated to receive identification and include arrows to show normal direction of flow.
- D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
 - 3. Near locations where pipes pass through walls, ceilings, or enter non-accessible enclosures.
 - 4. Near major equipment items and other points of origination and termination.
 - 5. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
- E. Do not mark piping exposed in finished occupied spaces.
- F. Plumbing Equipment Identification: Install an engraved plastic laminate sign on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for all major items of plumbing equipment.
- G. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 220230

SECTION 220240 - PLUMBING WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DOCUMENTATION PROCEDURES:

- A. Signed Commitments: Do not proceed with transfer of plumbing systems to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Design Professional (for Owner's records).

1.3 RECORD DRAWINGS:

- A. Explanation: Except where otherwise indicated, plumbing drawings (contract drawings) prepared by Design Professional, contract/drawings, are diagrammatic in nature and may not show locations accurately for various components of plumbing systems. Shop drawings, including coordination drawings, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.
- B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of plumbing contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate systems. In general, record every substantive installation of plumbing work which previously is either not shown or shown inaccurately, but in any case, record the following:
 - 1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
 - 2. Plumbing "Project Record" shall be maintained as part of the "Project Record" specified in Division 1.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

- A. General Coordination: Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.
- B. System Performance Test Run: At the time of plumbing work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Design Professional present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Design Professional's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Design Professional's final inspection of the plumbing work.
- C. Cleaning and Lubrication: After final performance test run of each plumbing system, clean system both externally and internally. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as plumbing work; refinish work where damage is extensive.
- D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual plumbing sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the plumbing systems. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building.
 - 1. Describe each basic system and how its control system functions, including flow adjustments, temperature control and similar operations.
 - 2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
 - 3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing and shutdown.
 - 4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances.
 - 5. Outline basic maintenance procedures.
- E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.
- F. Point out operational security provisions, safety, unavoidable hazards, and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.

- G. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

- A. Final Acceptance: At time of substantial completion of plumbing work, Owner's operating personnel will take over operation of plumbing systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise.

END OF SECTION 220240

SECTION 220310 – PLUMBING PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Qualify welding procedures, welders, and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
2. Certify welding of piping work using the standard procedure specifications by, and welders tested under supervision of, the National Certified Pipe Welding Bureau.
3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the National Sanitation Foundation (NSF).
4. Press joint fittings shall be installed using the proper tool, actuator, jaws, and rings as instructed by the press fitting manufacturer. Installing contractor shall be familiar with the installation of press joint systems and qualified through training provided directly by the fitting manufacturer.

B. Submittals:

1. Submit manufacturer's data, welding certifications, press to connect fitting training certifications, test reports, and product warranties as applicable for all piping materials.
2. Grooved joint couplings and fittings and press joint fittings shall be shown on drawings and product submittals and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Provide pipe and tube of the type, joint type, grade, size, and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.
- B. Copper Tube: ASTM B88-89 Type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated. Solder for use on domestic water piping shall be lead free type.
- C. Copper Tube DWV: ASTM B 306-88 type.

- D. Hubless Cast-Iron Soil Pipe: CISPI 301 or ASTM A 888 including standards for heavy duty coupling assembly ASTM C 564 and ASTM C 1540. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF.
- E. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74 including ASTM C 564 and ASTM C1563 for compression gaskets. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.
- F. Plastic Pipe:
 - 1. PVC-WATER: ASTM D2466-88.
 - 2. PVC-DWV: ASTM D2665-88.
 - 3. ABS-DWV: ASTM D2661-87.
 - 4. CPVC-WATER: ASTM D2846, ASTM F441 and ASTM F442 with socket type solvent cement or threaded fittings and joints complying with ASTM F 437, ASTM F438 and ASTM F439.
 - 5. Polypropylene: ASTM F 2389-06 (PP) Piping Systems, CSA B137.11 (PP-R) Pipe and Fittings for pressure applications, NSF/ANSI 14 and 61. Pipe and fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. Pipe and fittings shall be provided with a factory applied, UV-resistant coating.

2.2 PIPE/TUBE FITTINGS:

- A. General: Provide factory-fabricated fittings of the type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.
- B. Cast-Iron Threaded Fittings for Steel Pipe: ASTM A 126-84 Class 125, plain or galvanized to match pipe.
- C. Welded Fittings for Steel Pipe: ASTM A234.
- D. Cast-Iron Flanged Fittings for Steel Pipe: ASME B16.1, including bolting. Class 125, plain or galvanized to match pipe.
- E. Gaskets for Flanged Joints: ASME B16.21; full faced for cast-iron flanges.
- F. Gaskets for Hub and Spigot Pipe and Hubless Couplings: ASTM C 564, and ASTM C 1540 for heavy duty couplings, ASTM C 1563 for compression gaskets, and CISPI 310 or ASTM C 1277 for standard duty couplings.
- G. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.
 - 1. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
- H. Mechanical Couplings for IPS Pipe: Coupling housings shall be ductile iron (ASTM A536).

Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 to +230 F. At joints allowing controlled movement, expansion, contraction of deflection, flexible couplings with shall be used. At all joints not requiring flexibility, a rigid coupling shall be used. Fittings for pipe 2" and smaller shall be the mechanical compression type. Mechanical couplings shall be by Victaulic, Anvil, or Grinnell.

1. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
 2. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
 3. Flange Adapter: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.
- I. Grooved End Fittings for Steel Pipe: Fittings shall be ductile iron (ASTM A536) forged steel (ASTM A234); or fabricated from carbon steel pipe (ASTM A53); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
- J. Mechanical Couplings for Hard Copper Tube: Coupling housings shall be ductile iron (ASTM A536), coated with copper colored alkyd enamel and cast with angle-pattern bolt pads for system rigidity. Bolts and nuts shall be carbon steel track-type (ASTM A183), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM FlushSeal® type, for water services from -30 to +230EF. Mechanical couplings shall be by Victaulic, Anvil, or Grinnell.
- K. Mechanical Couplings for Copper Pipe: Fittings 2"-4" size shall be wrought copper (ASTM B75 C12200 or ASTM B152 C11000 and ANSI B 16.22). Fittings 5" - 8" size shall be bronze sand casting (ASTM B584-87) or copper alloy CDA844 (81-3-7-9) (ANSI B 16.18). Fittings shall have pre-grooved ends for use with mechanical couplings of the same manufacturer. Fittings shall be manufactured to copper tubing sizes. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)
- L. Copper Press Joint Fittings: Fittings 2" and smaller size shall be wrought-copper or cast copper alloy with EPDM-rubber, O-ring seal and inboard bead design in each end. Fittings 2-1/2"-4" size shall be wrought-copper fitting with EPDM-rubber, O-ring seal and inboard bead design in each end. Fittings shall be compatible with seamless K, L, or M copper tube made to ASTM B 88 and have a maximum non-shock working pressure of 200 PSI between the temperatures of -20 F and +250 F. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18, ASME B16.22, or ASME B16.26 and performance criteria of ASME B16.51 and IAPMO PS 117.
- M. Steel Press Joint Fittings: Fittings 2" and smaller shall be carbon steel with HNBR sealing element, 420 stainless steel grip ring and 304 stainless steel separator ring. Fittings 2-1/2"-4" size shall be carbon steel with HNBR sealing element and graphite separator ring. Fittings shall be designed specifically for gas and fuel oil applications with Schedule 5 to Schedule 40 carbon steel pipe and have a corrosion-resistant zinc nickel coating. Fittings shall have CSA LC-4, 125-psig pressure rating.
- N. Solvent Cement for PVC Joints: D2564-88.
- O. Solvent Cement for ABS Joints: D2235-88.

- P. Fusion Welding for Polypropylene Joints: Socket-fusion, electro-fusion, or butt-fusion, as applicable, in accordance with ASTM F 2389 and the manufacturer's specifications.
- Q. Pipe Sleeves:
1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
 2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3" pipe and smaller, 20-gauge; 4" - 6" pipe, 16-gauge; over 6" pipe, 14-gauge.
 3. Pipe Sleeve Caulking: 3M, except where another caulking system or material is specified or approved by Jaco or Flamestopper.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
1. Comply with ASME B31.1 Code for Pressure Piping.
 2. Comply with ASME B31.9 Code for Building Services Piping.
- B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details, and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1" clearance outside insulation. Changes in direction shall be made with fittings.
- C. Piping System Joints: Provide joints of the type indicated in each piping system.
- D. Threaded Joints: Thread pipe in accordance with ANSI B2.12; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- E. Welded Joints: Weld pipe joints in accordance with recognized industry practice and as follows: Weld pipe joints only when ambient temperature is above 0 F. where possible. Bevel pipe ends at a 37.5-degree angle where possible, smooth rough cuts and clean to remove slag, metal particles and dirt. Install welding rings for butt welded joints. Use pipe clamps or tack-weld joints with 1" long welds; (4) welds for pipe sizes to 10". Build up welds with a stringer-bead pass, followed by a hot pass, followed by a cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and non-metallic

- inclusions. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements. Install forged branch-connection fittings wherever branch pipe is indicated or install regular "T" fitting (at Contractor's option).
- F. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
 - G. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer's specifications. Lubricate gaskets completely on interior and exterior using a non-petroleum-based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2" and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.
 - H. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95% tin and 5% antimony.
 - I. Press Joints: Press tube and fitting joints where required, in accordance with the manufacturer's installation instructions. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings before assembly. The tubing end shall be clean and dry before being inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
 - J. Fusion Welding for Polypropylene Joints: Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.
 - K. Hubless Cast-Iron Joints: Comply with the manufacturer's installation instructions, CISPI 310 and local code requirements.
 - L. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations and

with applicable industry standards. Install all storm, soil, waste, and vent plastic pipe underground in compliance with ASTM D 2321.

- M. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.
- N. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors, or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 1/4" above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
 - 1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.
 - 2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe sleeves.
 - 3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.
 - 4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated. Provide sufficient quantities of oakum and lead to make permanent weather-tight closure between sleeve and piping, slightly recessed at exposed surface.
- O. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING, AND INSPECTING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.
- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Required test period is (2) hours.
- B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100-psig test pressure.
- C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

- D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 220310

SECTION 220320 – PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory-fabricated piping hangers and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.
- B. Hangers for domestic hot and cold water piping shall be copper plated band type with adjusting nut; Anvil, B-Line, Erico Caddy, PHD Manufacturing or Hubbard Enterprises/Holdrite.
- C. Hangers for cast iron or plastic drain and vent piping, shall be Clevis type, B-Line, Anvil, Erico Caddy, PHD Manufacturing or Hubbard Enterprises/Holdrite.
- D. Special Hangers: Special hangers and attachments shall be as detailed or indicated on the drawings.
- E. Piping installed above a roof shall be supported on prefabricated, non-penetrating supports by Pipe Pier, B-Line or Cooper. Provide matching adjustable elevation kits and method for positive attachment to roof.
- F. Piping roof penetrations shall be made with a factory-built pipe portal assembly with minimum 20-year warranty. The pipe portal shall be aluminum construction with removable lid, UV protected powder coating, full thermal break interior with gaskets and insulation, stainless steel fasteners and exit seal locater/starter dimples. The roof curb shall be aluminum construction with full thermal break interior. Exit seals shall be injection molded ABS. All pipe penetrations shall be through housing walls, not the lid. Select housing size in accordance with number of pipe penetrations needed. Pipe portal shall be by Alta, Roof Penetration Housings, Pate, Thybar, or RPS.

PART 3 - EXECUTION

3.1 HORIZONTAL PIPING SUPPORT:

- A. Maximum spacing of hangers and supports for above-ground horizontal pipe and tubing shall be in accordance with the applicable International Plumbing Code.
- B. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.
- C. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.
- D. Piping installed above a roof shall be supported on prefabricated, non-penetrating supports by Pipe Pier or approved equal. Provide matching adjustable elevation kits.

3.2 VERTICAL PIPING SUPPORT:

- A. Maximum spacing of vertical supports for pipe and tubing shall be in accordance with the applicable International Plumbing Code.
- B. Fixture Supports: See Fixture Schedule. Provide concealed supports and carriers recommended by the manufacturer of the fixtures and equipment to suit the structural and finish conditions.

3.3 ADJUSTMENT OF HANGERS AND SUPPORTS:

- A. Adjust hangers and supports to bring piping to proper level, elevations, and slopes.

END OF SECTION 220320

SECTION 220330 – PLUMBING EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordination: Where excavation and backfill for plumbing work passes through or occurs in the same areas as work specified in the Division 02 sections, comply with both the requirements of the Division 02 sections and the requirements of this section, whichever is the more stringent (as determined by the Design Professional in cases of conflicting requirements).

1.3 JOB CONDITIONS:

- A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

- A. Subbase Material: A graded mixture of gravel, sand, crushed stone, or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

- A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.

B. General:

1. Do not excavate until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Provide signs, illuminations, and barricades as necessary to prevent accidents at

- excavations.
3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
 4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves, and other work. Provide a minimum of 12" clearance around underground tanks.
 5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
 - a. Piping of 5" and less pipe/tube size.
 - b. Cast-in-place concrete.
 6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
 7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
 8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
 - a. Retain excavated material which complies with the requirements for backfill material.
 - b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

- A. Maintain dry excavations by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment, or erosion from or through excavations.

3.3 BASE PREPARATION:

- A. Install subbase material to receive plumbing work and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.
- B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves, and similar enlargements in the piping systems.

3.4 BACKFILLING:

- A. Do not backfill until installed work has been tested and accepted, wherever testing is indicated.
- B. Condition backfill material by either drying or adding water uniformly, to whatever extent

may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.

- C. Backfill simultaneously on opposite sides of work and compact simultaneously; do not dislocate the work from installed positions.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
 - 1. Lawn/Landscaped Areas: 90%
 - 2. Roadways: 95%
 - 3. Paved Area, Other than Roadways: 95%
- E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
- F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Design Professional.

3.5 PERFORMANCE AND MAINTENANCE:

- A. Where subsidence is measurable or observable at plumbing work excavations during the guarantee period, remove the surface (pavement, lawn, or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 220330

SECTION 221110 - DOMESTIC WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Code Compliance: Comply with governing regulations which require the products used for domestic water piping work to be selected from lists in certain published standards or codes as indicated therein.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.
- B. Provide certified copy of contractor's sterilization test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Comply with section 220310 for product requirements of piping materials. For each service, provide the piping materials indicated including, pipe, fitting, hangers, supports, anchors, valves, and accessories. Where more than one type is indicated, selection is Installer's option. Where type is not otherwise indicated, provide materials complying with governing regulations.

B. Service Water Piping:

- 1. Pipe Sizes 4" and Smaller: Copper tube or CPVC of the size indicated.
- 2. Wall Thickness: Type K or Schedule 80 CPVC
- 3. Fittings: Wrought copper-solder joint (with lead free solder).
Schedule 80 CPVC joint (with solvent cement).

C. Water Distribution Piping:

- 1. Pipe Sizes 4" and Smaller: Copper tube of the size indicated or CPVC.
- 2. Wall Thickness: Type K (belowground) or Schedule 80 CPVC.
Type L (above ground) or Schedule 80 CPVC.
CTS CPVC is allowed for piping 2" and smaller.
- 3. Fittings: Wrought copper-solder joint (with lead free solder).

D. Reverse Osmosis Piping:

1. Pipe Sizes 4" and Smaller: Pressure-rated Polypropylene.
2. Fittings: Polypropylene socket-fusion, electrofusion, or butt fusion type.

2.2 ACCESSORIES:

- A. General: Provide factory-fabricated piping products of the size, type, rating, and capacity indicated. Where not indicated, provide proper selection as determined by the Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections.
- B. Watts is an approved manufacturer for water supply products.
- C. Water Hammer Arrestors: Bellows type; precharged compressor chamber; stainless steel casing and bellows. Provide sizes complying with PDI Standard WH-201. Josam, Jay R. Smith, Watts, or Zurn.
- D. Exterior Wall Hydrant HB/E: All brass freezeproof automatic draining type with stainless steel mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Hydrants shall be Woodford, Josam, Watts, Prier, or Zurn.
- E. Exterior Wall Hydrant HB/F: All brass freezeproof automatic draining type with polished brass finish, flush mounting, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Hydrants shall be Woodford, Josam, Watts, Prier, or Zurn.
- F. Interior Wall Hydrant HB/B: All brass with polished brass finish, flush mounting wall box, adjustable packing nut, teflon impregnated packing, vacuum breaker with hose thread and loose key operated. Hydrants shall be Woodford, Josam, Watts, Prier, or Zurn.
- G. Roof Hydrant HB/R: Exposed, non-freeze roof hydrant, with coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing. Roof hydrant shall be drainless type. Complete with coated cast iron roof support sleeve with wide anchoring flange and clamp collar. Hydrants shall be Zurn, Watts, Woodford, Prier, or Josam.
- H. Domestic Water Piping Strainers: Strainers shall be a "Y" bronze body type with 20 mesh stainless steel screen, and threaded ends, rated for 250 psig wwp at 210 F. Strainers shall be Watts, Wilkins, Keckley, or Mueller.
- I. Flow Control Valves: Valves for domestic hot water return shall have brass and stainless steel bodies, with integral ball valve, ground joint union, and solder ends. Valve shall be rated for 600 psig and flow rate, as shown on drawings. Flow control valves shall be Autoflow, Hays, or Griswold.

- J. Thermostatic Balancing Valves: Valves for domestic hot water return shall be a self-acting thermostatic recirculation valve that automatically and continuously maintains the end of each domestic hot water supply line at the specified water temperature. Valve shall be stainless steel in construction and include set or adjustable temperature setpoints. Valve assembly shall include strainer and ball valves at each end. Valve temperature shall be set to match recirculating pump activation temperature. Thermostatic balancing valves shall be CircuitSolver, Caleffi, Leonard, or Xylem.
- K. Thermostatic Mixing Valves (TMV): Valves shall be of brass, stainless-steel and polymer construction. TMV shall have NPT inlets and outlet with integral inlet spring loaded check valves and strainers. Mixing valves shall be equipped with a maximum temperature limiting and single temperature locking feature. TMV shall be designed so that all internal operating components are enclosed in a one-piece replaceable cartridge for ease of service. Valves shall be capable of controlling mixed water temperatures +/- 2 F at flow rates between 0.5 and 11 gpm. Mixing valve shall be Powers, Armstrong/Rada, or Leonard.
- L. Pressure Reducing Valves: Valves shall be bronze body construction with renewable seats and integral check valve and strainer. Pressure reducing valves shall be Watts, Wilkins, Zurn, or Conbraco.
- M. Pressure Relief Valves: Valves shall be bronze construction engineered in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code for Heating Boilers. Capacities shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valves shall be Bell & Gossett, Taco, Watts, or Armstrong.
- N. Gate Valves: Valves 3" and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet, solid wedge, non-rising stem type and rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be Milwaukee, Nibco, Watts, Jomar, or Red-White.
- O. Globe Valves: Valves 3" and smaller shall be all bronze, meeting MSS-SP80, inserted bonnet with integral seat and renewable disc. Valves shall be rated at 125 SWP, 200 WOG. Handles shall be malleable iron with bronze stem. Valves shall be Watts, Milwaukee, Nibco, Watts, Jomar, or Red-White.
- P. Check Valves: Valves 2" and smaller shall be bronze body with bronze seat and disc and shall be rated at 125 SWP, 200 WOG. Valves shall be Milwaukee, Nibco, Watts, Jomar, or Red-White.
- Q. Ball Valves: Ball valves may be substituted for gate valves at the contractor's option. Ball valves shall have two-piece bronze or brass body, meeting MSS-SP110, full or standard port, blowout-proof stem and adjustable packing nut independent of handle. Valves shall be rated for 150 SWP, 600 WOG or 300 CWP. Valves shall be Apollo, Milwaukee, Nibco, Victaulic, Watts Smith-Cooper, Jomar, or Red-White.
- R. Thermometers: Piping systems thermometers shall be the red-reading mercury filled adjustable angle type. Thermometers shall be adjustable to any angle through a 180-degree arc and shall be provided with a locking device. Where possible, thermometers shall be installed not higher than 8' above finished floor. Final positioning of each thermometer shall be such that it is readable from the floor, and it shall be locked in that position. Thermometers shall have V-cast aluminum case with baked enamel finish and 9" scale.

- Thermometers shall be provided with separable sockets, and where installed on insulated pipes, sockets shall be extension neck type. Thermometer scale range shall be 30 to 300 F for hot water systems. Thermometers shall be Omega, Wika, Terrice, Winters or Weiss.
- S. Pressure Gauges: Gauges shall be connected to the piping system with threaded brass pipe and fittings. Gauges shall be the flangeless type and shall have 4-1/2" dials, cast aluminum cases, stainless-steel, heavy-duty rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2 % accuracy of scale range, plexiglass dial covers, and 1/4" lower connections. Each gauge shall be provided with brass lever handle cock and a stainless-steel pulsation dampener. Provide compound gauges for locations which under negative pressure. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Gauges shall be Omega, Wika, Terrice, Winters or Weiss.
 - T. Access Panel: Access panels shall be 16-gauge steel door and frame with concealed hinge and vandal resistant latch. Panels shall be flush type. Access panel shall be J. R. Smith, Watts, Zurn, Josam or Mifab.
 - U. Heat Trace Tape For Domestic Water Piping: Heat trace tape shall be the self-regulating type and shall be Raychem Model HWAT-D. Heat trace tape shall be sized to maintain 40 F water temperature. Voltage shall be 120/1PH/60HZ.
 - V. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.
 - W. Automatic Air Vents: Provide automatic float type air vents in locations indicated on the drawings. Units shall be suitable for a maximum working pressure of 75 psig and a maximum operating temperature of 240 F. Automatic air vents shall be Taco, Bell & Gossett, Amtrol, Wheatley or Armstrong.
 - X. Manual Air Vents: Vents shall consist of a 1/4" gauge cock with soft drawn copper discharge tube.
 - Y. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3" pipe and smaller, 20-gauge; 4" – 6" pipe, 16-gauge; over 6" pipe, 14-gauge.
 - Z. Pipe Sleeve Caulking: 3M Fire Barrier Caulk, CP25N/S, except where another caulking system or material is specified, or equivalent by Hilti or Tremco.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

- A. General: Comply with the requirements of section 220310 for installation of basic piping materials.
- B. Expansion Compensation: Except as otherwise indicated, install piping, including mains, branches, and runouts with offsets to allow for free expansion and contraction sufficient to

prevent leaks and over-stressing of the piping system.

- C. Sterilization: The entire water distribution system shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be liquid chlorine conforming to Federal Specification BB-C-120. The sterilization solution shall be allowed to remain in the system for a period of 24 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. After completion of sterilization water samples shall be sent to the Local Health Department (LDH) for testing. Approval must be received from LDH before the system is put into service.

3.2 INSTALLATION OF ACCESSORIES:

- A. Install premanufactured accessories in accordance with the manufacturer's instructions and recommendations.
- B. Access Panel: Install access panels as shown on drawings. Paint access panels to match walls or ceilings.
- C. Escutcheon Plates: Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.
- D. Heat Trace Tape: Heat trace tape shall be installed on bare pipe prior to insulating. Tape installation shall be in accordance with the manufacturer's instructions and/or per details on the drawings.
- E. Water Hammer Arrestors: Install units at the top of each riser or as otherwise indicated to comply with PDI Standard WH-201.
- F. Air Vents: Install manual air vents at high points in the system and as shown on the drawings.

END OF SECTION 221110

SECTION 221210 - SOIL, WASTE, VENT AND STORM PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

1.3 QUALITY ASSURANCE:

- A. Industry Standards: Comply with local regulations, the International Plumbing Code and standards established by the Plumbing and Drainage Institute (PDI) pertaining to floor drains.
- B. General: Provide factory-fabricated drainage piping products of the size and type indicated. Where not indicated, provide proper selection as determined by the Installer to comply with the installation requirements and governing regulations. Contractor shall coordinate drainage products selected with finish conditions encountered.
- C. Cast Iron Pipe: All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Comply with section 220310 for product requirements of piping materials. For each service, provide the piping materials indicated, including pipe, fittings, joints, hangers, supports, anchors, and accessories. Where type is not otherwise indicated, provide materials complying with governing regulations.
- B. Watts, Mifab, and Wade are approved manufacturers for drainage products.
- C. Soil, Waste and Vent Piping (Belowground):
 - 1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
 - 2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

D. Soil, Waste Drain and Vent Piping (Above Ground):

1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
2. Hub less cast iron pipe and fittings conforming to CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using heavy-duty ASTM C 1540 and ASTM C 564 stainless steel no-hub couplings or cast iron no-hub couplings.
3. Galvanized steel pipe with threaded cast iron fittings or DWV Type copper pipe with solder joint fittings may be used for waste and vent piping 1-1/2" and 1-1/4" in size.

E. Storm Drain Piping (Below Ground):

1. Schedule 40 ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type.
2. Service weight cast iron hub and spigot pipe and fittings, ASTM A74. Joints in underground cast iron piping shall be made using an ASTM-C564 neoprene elastomeric compression gasket conforming to the requirements of ASTM C 1563.

F. Storm Drain Piping (Above Ground):

1. Schedule 40 plastic ABS-DWV or PVC-DWV pipe and fittings. Joints shall be solvent cement socket type above ground. If ABS or DWV pipe and fittings are used aboveground all penetrations of rated walls, floors, and assemblies shall be protected in an approved manner, including penetrations of one side of an assembly.
2. Hub less cast iron pipe and fittings, CISPI 301 or ASTM A888. Joints in above ground cast iron shall be made using stainless steel no-hub standard couplings, CISPI 310, ASTM C 1277 and ASTM C564 or stainless steel no-hub heavy duty couplings, ASTM C 1540 and ASTM C 564.

2.2 FLOOR DRAINS AND ROOF DRAINS:

- A. Drains installed in waterproofed floors and roofs shall be provided with flashing clamps.
- B. Floor Drain FD-A: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, vandal-proof screws and 6" diameter round Nikaloy strainer. Drains shall be J.R. Smith, Josam, Watts, or Zurn.
- C. Floor Drain FD-B: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 9" diameter round Nikaloy strainer with raised flange. Where indicated on the drawings, drain shall have a trap primer connection. Drains shall be J.R. Smith, Josam, Watts, or Zurn.
- D. Floor Drain FD-C: shall have a coated cast iron body with integral pipe stops, flashing collar, seepage flange, sediment bucket, vandal-proof screws and 8" diameter polished nickel bronze strainer and oval funnel. Drains shall be J.R. Smith, Josam, Watts, or Zurn.
- E. Roof Drains RD-A: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, aluminum mushroom dome, and no-hub

connection. Drains shall be J.R. Smith, Josam, Watts, or Zurn.

- F. Roof Drains RD-B: shall have a coated cast iron body with adjustable top, clamp ring/gravel stop, large sump, deck clamp, drain receiver, 3" cast iron standpipe, aluminum mushroom dome, and no-hub connection. Drains shall be J.R. Smith, Josam, Watts, or Zurn.
- G. Hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1" above the finished floor. Waste piping from fixtures and equipment shall be connected solid into the hub.
- H. Open hub drains shall have a pipe hub (or one pipe size increaser if plastic pipe is used) set in the floor with the top 1" above the finished floor. Indirect waste piping shall terminate 2" above the top of the hub.

2.3 CLEANOUTS:

- A. Cleanout plugs shall be cast bronze or brass countersunk type with taper threads complying with ANSI B2.
- B. Cleanouts on underground drainage shall have piping extended to the floor and finished with cleanout plug and removable floor plate.
- C. Cleanouts shall be the same size as the pipe on which installed, except cleanouts on underground piping shall be a maximum of 4".
- D. Cleanouts in waterproofed floors shall have flashing clamp.
- E. Cleanouts in carpeted floors shall be provided with a carpet marker.
- F. Concrete Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, vandal-proof securing screw, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.
- G. Quarry Tile or Ceramic Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square scoriated nickel bronze cover and rim, vandal-proof securing screw, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.
- H. Resilient Tile Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable square nickel bronze cover recessed for tile, vandal-proof securing screw, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.
- I. Terrazzo Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round nickel bronze cover recessed for terrazzo, vandal-proof securing screw, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.
- J. Carpeted Floors: Cleanouts shall have cast iron body with integral pipe stop, adjustable round scoriated nickel bronze cover and rim, bronze carpet marker, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.
- K. Exterior Areas: Cleanouts to grade shall have cast iron body with integral pipe stop, heavy

duty round cast iron tractor cover with vandal-proof screw, and countersunk bronze plug. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.

- L. Wall Cleanouts: shall consist of a threaded recessed tapped cleanout tee with tapered thread bronze plug, vandal-proof securing screw, and round stainless-steel wall plate. Cleanouts shall be J.R. Smith, Josam, Zurn, or Watts.

2.4 DRAINAGE ACCESSORIES:

- A. Flashing for Plumbing Vent Piping Passing Through Roofs: Unless otherwise indicated, flashing for plumbing VTR's shall be Stoneman "Stormtite" Model S1000-4, open top, 4-pound seamless lead flashing assembly or equivalent. Install flashing in accordance with manufacturer's instructions.
- B. Escutcheon Plates: Metal split-ring type units, with nickel or chrome plated finish. Provide units sized to fit closely outside of pipe insulation or bare pipe where no covering is required.
- C. Downspout Nozzle: Cast Nikaloy downspout nozzle with loose wall flange, insect screen and threaded inlet connection. Fabricated round stainless steel frame with fabricated secured perforated stainless steel strainer. Nozzle size shall match size of connecting storm drainpipe shown on drawings. Downspout nozzles shall be Josam, J.R. Smith, Watts or Zurn.
- D. Inline Floor Drain Trap Sealer: Provide trap sealer with ASB plastic body, keeper pin neoprene rubber diaphragm and sealing gasket. Trap sealer unit shall comply with the requirements of ASSE 1072. Basis of design is Sure Seal.
- E. Sidewall Vent Air Inlets: Provide polished bronze body with securing mechanism and vandal-proof screws. Air inlets shall be J. R. Smith, Watts or Zurn.

2.5 DRAINAGE PUMPS:

- A. Elevator Sump Pumps (SP-1):
 - 1. Sump pump shall be a single stage submersible pump with NEMA 4x weathertight corrosion resistant fiberglass housing, stainless steel sensor probe, single direct plug-in power source. Pump system shall meet the requirements of UL508 and UL778. Pump shall have the capacities shown on the drawings and shall have electrical characteristics shown on the drawings.
 - 2. Sump pump system shall include oil monitoring control system and panel. Oil monitoring control system shall include monitoring panel, alarm, light and remote monitoring circuit. Panel shall provide alarms for oil spill, power, high liquid level, overload, and pump run. Oil monitoring system shall report to the fire alarm control panel.
 - 3. Pump shall be controlled by a float switch mounted directly on the pump. Pump motor and float shall be built as a manufactured unit. Pump and oil monitoring system shall be provided as a packaged unit. Pumps shall be Stancor, Grundfos, Zoeller or Liberty.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

- A. General: Comply with the requirements of section 220310 for installation of basic materials.
- B. Testing: The piping of the soil, waste and vent system shall be tested with water before installing fixtures. Water test shall be applied to the soil, waste, and venting system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10' head of water. In testing successive sections, at least the upper 10' of the next preceding section shall be tested so that each joint or pipe in the building except the upper most 10' of the system has been submitted to a test of at least 10' head of water. The water shall be kept in the system, or in the portion under test, for at least (30) minutes before the inspection starts; the system shall be tight at all joints. Joints that fail the test shall be remade and retested.
- C. Protection: The installer of drains shall advise the Contractor of required protection for the drains during the remainder of the construction periods, to avoid clogging with construction materials and debris to prevent damage from traffic and construction work.
- D. During construction all pipe openings shall be capped or plugged, when not being worked on, to prevent foreign objects and construction debris from entering system.
- E. Horizontal drainage piping 2-1/2" and smaller shall be graded at a minimum of 1/4" per foot, unless noted otherwise. Horizontal drainage piping 3" and larger shall be graded at a minimum of 1/8" per foot, unless noted otherwise. Horizontal drainage piping to the inlet of the grease interceptor shall be graded at a minimum of 1/4" per foot.
- F. All underground plastic soil, waste and vent and storm drainage piping shall be installed in compliance with ASTM D2321.

3.2 INSTALLATION OF ACCESSORIES:

- A. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior and elsewhere as indicated.
- B. Cleanouts in vertical piping shall be roughed-in with the centerline 18" above the finished floor.
- C. Install drains in accordance with manufacturer's written instructions and in locations indicated.
- D. Coordinate with soil and waste piping as necessary to interface drains with drainage piping system.
- E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Install drains at low points of the surface areas to be drained. Set tops of drains flush with

finished floor or deck.

- G. The installer shall advise the General Contractor of required protection for drains and cleanouts during the remainder of the construction period, to prevent damage from traffic and construction work.
- H. After installation, cover the tops of drains with duct tape or some other strong material during the remainder of the construction process, to avoid clogging with construction materials and debris.

END OF SECTION 221210

SECTION 221610 – PLUMBING PIPING SYSTEM INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE:

- A. Plumbing piping systems to be insulated include:
 - 1. Domestic Hot and Cold Water Piping, Above Ground
 - 2. Horizontal Roof Drain Piping and Drain Bodies Above Floor (including secondary system)

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation: Certainteed, Knauf, Johns Manville, Owens-Corning, Pittsburgh Corning, or Manson.
- B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics, and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by ASTM E 84 (NFPA 255) method and UL 723.

1.4 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

- A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self-sealing ASJ facing conforming to ASTM C 547. Valves and fittings shall be insulated with fiberglass insulation of the same material thickness as insulation on adjacent pipe and having a molded PVC jacket. Jackets shall be Certainteed, Knauf, or Zeston. Insulation thickness shall be as follows:
 - 1. Domestic Cold Water Piping: 1” thick for all sizes.
 - 2. Domestic Hot Water Piping: 1” thick for all sizes up to and including 1¼” in size.

3. Domestic Hot Water Piping: 1-1/2" thick for all sizes greater than 1-1/4" in size.
 4. Horizontal Roof Drain Piping: 1" thick for all sizes.
- B. Aluminum Jacket: Corrugated, embossed or smooth sheet, 0.016" nominal thickness, ASTM B 209, temper H14, type 3003, 5005 or 5010. Provide stainless steel bands, minimum width of 1/2".

PART 3 - EXECUTION

3.1 APPLICATION REQUIREMENTS:

- A. General: Insulate all above ground domestic hot and cold water piping except do not insulate supplies to fixtures unless specifically required. Insulate horizontal waste lines receiving the discharge from HVAC drains. Insulate the underside of all roof drains and all roof drain piping installed above conditioned spaces.
- B. Aluminum jackets shall be provided on all exterior insulated pipes.
- C. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens and mechanical rooms aluminum jackets shall be provided. Pipe insulation to the 6' level shall be protected.

3.2 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.
- B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12" long by 180 degrees and shall be 18-gauge galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.
- D. Unions shall not be insulated.
- E. Cover valves, flanges, fittings, and similar items in each piping system.
- F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.

- G. The body (underside) of roof drains shall be insulated with blanket type fiberglass insulation. Overlap ends of insulation a minimum of 2". Overlap bottom of insulation a minimum of 3" at pipe connection. Adhere insulation to roof drain with 100% coverage of fire retardant adhesive. Tape all joints with 3" wide foil reinforced Kraft tape.

3.3 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: The installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 221610

SECTION 221710 - PLUMBING VIBRATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Furnish all labor, materials, tools, and equipment and perform all work necessary to complete the installation of the plumbing [vibration and] seismic control systems required by these specifications and as detailed on the drawings.
- B. All foundations and supports required for the installation of plumbing equipment shall be furnished by the plumbing contractor shall unless specifically specified otherwise.
- C. The following criteria applies to all mechanical systems and components:
 - 1. Seismic Design Category: C
 - 2. Typical Importance Factor: 1.0

1.3 QUALITY ASSURANCE:

- A. Codes and Standards: The installation of the plumbing systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic snubbers, seismic restraints, and vibration isolators shall also meet the requirements as set forth in the following current standards and codes.
 - 1. International Building Code (IBC)
 - 2. ASHRAE
 - 3. SMACNA Seismic Restraint Manual
 - 4. ASTM 488 Anchor Locations
 - 5. FEMA Standards
- B. The plumbing vibration and seismic control products shall be sized and provided by the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.
- C. Kinetics Noise Control is the Basis of Design manufacturer. Equivalent equipment by AeroSonics, Mason, Vibration Eliminator, Vibro-Acoustics and Vibration Mountings and Controls that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- D. Submittals:

1. The contractor shall submit for approval by the Design professional all products intended to be used to meet the requirements of these specifications. Submittal data shall include a proposed schedule for vibration isolation products, manufacturer's data and cut sheets of the specific vibration isolation and seismic control materials. Proposed vibration isolation schedule shall list all equipment specified to be isolated, the equipment weight, proposed isolator type or base type, number of isolators required, spring or isolator color, and deflection of the spring or vibration isolator based on equipment weights.
2. The contractor shall submit for approval by the Design professional all seismic anchorage requirements for all equipment. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, and roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. Anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.
- B. The vibration isolation products and systems shall have a deflection as recommended by the manufacturer but not less than the deflection indicated in the Vibration Isolation Schedule.
- C. The vibration isolation manufacturer may select and propose non-seismic type isolators, provided snubbers are furnished and installed to limit the horizontal movement of equipment. Snubbers shall be selected to resist the maximum calculated lateral force of the equipment. Calculations shall be submitted and sealed by the professional engineer certifying the snubber's selection and anchorage requirements.

2.2 ISOLATOR TYPES:

- A. Type 5 - Floor Mounted Equipment (seismic): Vibration isolators shall be seismically rated and consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit vertical movement of the supported equipment and the horizontal movement. Housing assembly shall be formed or fabricated steel members and shall consist of a top-load plate complete with adjusting and leveling bolts, isolation washers and a bottom plate with non-skid noise stop pads and holes provided for anchoring to supporting structure. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Isolator shall be designed to allow replacement of the spring element without removing the spring isolator housing.

- B. Type 10 - Suspended Equipment and Piping: Vibration Isolators shall consist of a steel spring and neoprene element in series mounted in a stamped or welded steel bracket for insertion into the hanger rod assembly. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The steel spring shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit movement. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. The steel bracket shall be fabricated from steel and provided with a corrosion resistance finish. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. The hanger bracket shall incorporate spring caps with indexed steps, which correspond to the washer diameter of the hanger rod to keep the rod centered in the spring cap.

2.3 BASES:

- A. Type B - Concrete Inertia Bases: Bases shall consist of a concrete base cast into a welded galvanized steel-pouring frame with welded isolator brackets and steel reinforcing rods. Minimum depth shall be 6". Bases shall be specifically designed and fabricated to receive poured concrete for use in supporting the intended equipment. The concrete pouring frame shall contain 1/2" reinforcing rods on 8" centers each way. The isolator brackets shall be located on each corner of the pouring frame and be located so that a minimum of 1" clearance is provided in an operating condition between the bottom of the base and the support floor or base. Pouring frame shall contain a template for locating the anchor bolts for the supported equipment.

2.4 SEISMIC CONTROL:

- A. The mechanical systems serving the building shall be installed to meet the minimum requirements of the International Building Code regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Design Professional.
- B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.
- C. All equipment installed either floor or pad mounted or suspended from the structure shall be restrained and anchored unless exempt as hereinafter indicated.
- D. Where pipes or other plumbing systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible pipes to accommodate the seismic displacement of the two structures. Flexible pipes shall be installed on one side of the interface.
- E. The following plumbing components are exempt from seismic bracing or restraints:

1. All components in seismic design category D, E, and F, weighing 20 lbs or less when the importance factor = 1.0.
 2. Piping installed 12” or less from the point of connection to the supporting structure and the top of the pipe when the importance factor = 1.0.
 3. Equipment installed less than 4’-0” above the floor and weighing less than 400 lbs when the importance factor = 1.0.
 4. Any piping installed in a structure when the Seismic Design Category is A or B.
 5. Any piping installed in a structure when the Seismic Design Category is C and the importance factor = 1.0.
- F. Where systems are specified to have spring isolation hangers, the hangers shall be installed as close as possible to the supporting structure.
- G. Equipment installed on non-seismic type spring isolators shall have snubbers installed to limit the horizontal movement of the equipment in any direction.
- H. Seismic restraint cables or seismic restraint braces shall be installed on piping systems and suspended equipment. Seismic restraint cables shall be stranded steel cable provided with mounting hardware for connection to the equipment hanger rod, to the equipment housing or trapeze hangers. The stranded steel cables and hardware shall be the product of a single manufacture and shall have been tested for the intended use. Published data shall be available and submitted to identify the load limitations of the proposed restraint hardware. As a minimum the following cable sizes shall be used on piping and equipment:
1. Piping 1” to 2-1/2”:
1/16” steel cable
 2. Piping 3” to 8”:
3/16” steel cable
 3. Piping 10” and larger:
1/4” steel cable
 4. Equipment weighting 400 lbs or less:
3/16” steel cable
 5. Equipment weight 401 lbs and higher:
1/4” steel cable
- I. Anchorage of equipment to concrete floors and pads shall be in-accordance with the submitted anchorage calculations.
- J. Connections of seismic restraint cable hardware shall be in-accordance with the submitted anchorage calculations.

2.5 VIBRATION ISOLATION SCHEDULE FOR PLUMBING SYSTEMS:

<u>Equipment Type</u>	<u>Isolator Type</u>	<u>Base Type</u>	<u>Deflection</u>
Base Mounted Compressors/Pumps	Type 5	Type B	1.0”
In-line Pumps	Type 10	None	1.0”
Piping located in Mechanical Rooms	Type 10	None	1.0”

Notes:

1. Concrete inertia base for compressors/pumps up to 30 HP shall be 6” thick.
2. Concrete inertia base for compressors/pumps 40-75 HP shall be 8” thick.
3. Concrete inertia base for compressors/pumps 100 HP and larger shall be 12” thick]

PART 3 - EXECUTION

3.1 GENERAL:

- A. If the equipment provided is not furnished with integral structural steel supports, mounting feet, or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.
- B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.
- C. All equipment specified to be isolated shall be installed and isolators shall be attached to the building structure or floor and the vibration isolators shall be adjusted and leveled so that the vibration isolators are performing properly.
- D. All [vibration isolation products and] seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

3.2 VIBRATION ISOLATION AND SEISMIC CERTIFICATE OF COMPLIANCE:

- A. The manufacturer's representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of [vibration isolation and] seismic products.
- B. The manufacturer's representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer's installation instructions. Upon satisfaction that all devices are installed correctly and systems are isolated properly, the representative shall submit a written report outlining the installation as in compliance with these specifications and also the manufacturer's installation instructions.

END OF SECTION 221710

SECTION 222210 – WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide electric water heaters which have been listed and labeled by Underwriters' Laboratories.
2. Comply with National Electrical Code (NFPA 70) as applicable to installation and connection to electric water heaters.
3. Provide water heaters which have been listed and labeled by National Sanitation Foundation (NSF).
4. Provide water heaters with safety relief valves bearing ASME valve markings, all heaters.
5. Heaters(s) shall meet the requirements of ASHRAE 90.1, state energy requirements, and the BOCA Energy Conservation Code.
6. Coordinate power requirements of water heaters and accessories with electrical drawings and specifications.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, certifications, and product warranties on all items.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATERS:

- A. Electric Water Heater WH-1: Provide electric type factory assembled and wired vertical storage type water heaters. Provide with glass-lined welded steel tank, thermally insulated with foam type or fiberglass insulation and encased in corrosion resistant steel jacket with baked-on white enamel finish. Equip with drain valve, immersion heater, magnesium anode, emergency high limit cut-off switch to prevent over-heating, automatic thermostat with temperature range from 120 F to 170 F, and temperature and pressure relief valve. Heater shall carry manufacturer's standard warranty and shall meet or exceed the requirements of ASHRAE 90.1. Water heaters shall be A.O. Smith DEL Series, Bradford White LD Utility Series, or Rheem EGSP Series.

- B. Electric Water Heater WH-2: Provide electric type factory assembled and wired vertical storage type water heaters. Provide with glass-lined welded steel tank, thermally insulated

with foam type or fiberglass insulation, and encased in corrosion resistant steel jacket with baked-on white enamel finish. Equip with drain valve, immersion heater(s), magnesium anode, emergency high limit cut-off switch to prevent over-heating, automatic thermostat with temperature range from 120 F to 170 F, and temperature and pressure relief valve. Heater shall carry manufacturer's standard warranty and shall meet or exceed the requirements of ASHRAE 90.1. Water heaters shall be A.O. Smith DEN Series, Bradford White LD Series, or Rheem ELD Series.

2.2 ACCESSORIES:

- A. Domestic Hot Water Circulation Pump: Pump shall be the in-line centrifugal type designed for 125 psi working pressure with stainless steel body and impeller, mechanical seals, and stainless-steel impeller shaft. The pump motor shall be the open drip-proof design with sleeve bearings, built-in thermal over-load protectors, and shall operate at 1750 RPM. Pump shall have the capacities as shown on the drawings. Pump shall be Bell & Gossett - Booster Series, Taco - Circulation Series, Thrush - Circulator Series, or Grundfos - UP Circulator Series.
- B. Storage Tanks: Storage tanks shall be 2 gallon vertical water storage tank. Tanks shall be ASME constructed and stamped for 125 PSIG working pressure. Tanks shall be glass lined with magnesium anode rods. Storage tank shall be factory jacketed, insulated, and shall meet or exceed ASHRAE 90A standards. Storage tanks shall be Lochinvar Model RFA120 or equivalent.
- C. Thermal Expansion Tanks: Provide bladder type captive air expansion tanks with tank volume as indicated on the drawings. The shell shall be fabricated steel designed and constructed per ASME Section VIII. Tanks shall be suitable for potable water systems and maximum working pressure of 125 psig and a maximum operating temperature of 240 F. Tanks shall be by Taco, Amtrol, Watts, Proflo or Wheatley.
- D. Vacuum Relief Valve: Provide a vacuum relief valve for automatic venting of a closed system to atmosphere when a vacuum is created. Valve shall be tested and rated under ANSI Z21.22. Vacuum relief valves shall be a Watts LFN36, Cash-Acme FRM-V, or Wilkins VR10XL.
- E. Temperature Control Valve: Assembly shall be a Hi-Low Thermostatic Water Mixing Valve with large mixing valve with solid bimetal thermostat directly linked to valve porting, adjustable limit stop, color coded scale: Hot to Cold, wall support, inlet union angle stainer checkstops, outlet volume control/shutoff, pressure regulating valve with pressure gauges, small Mixing Valve, integral checkstops, solid bimetal thermostat, adjustable limit stop, color coded scale; Cold to Hot, wall support outlet volume control/shutoff dial thermometer (range: 0 F to 140 F), rough bronze finish, and inlet piping manifold with unions. Unit shall be FACTORY ASSEMBLED AND TESTED. Temperature control valves shall be Leonard TM-186-12520 PRV-D-LTR or equivalent by Powers or Lawler.
- F. Temperature Control Valve: Valve shall be a thermoscopic mixing valve with chrome finish, a maximum operating pressure of 125 PSIG and maximum operating temperature of 110 F at 45 PSIG equal supply pressures. Valve shall be provided with spring loaded angle union integral check stops, integral strainers and "Fail Safe" shutdown. Valve shall control temperature at ± 1 F and shall have minimum and maximum flow rates of 1 gallon per minute

and 26 gallons per minute respectively. Temperature control valves shall be RADA Model 20 or equal by Leonard, Symmons or Powers.

- G. Equipment Stand: Stand shall be 24" x 24" wide galvanized steel unit with 12-gauge galvanized steel top, 16-gauge galvanized steel legs, lag bolts, washers and safety clips. Stand shall be rated to carry a capacity of 1200 pounds. Equipment stands shall be Holdrite Quick Stand, Jones Stephens, Oatey, Sioux Chief, or Water-Tite.
- H. Water Heater Pan: Water heater pan shall be aluminum alloy pan with 2-1/2" high sides, 1" PVC drain, zinc plated steel lock nut and neoprene flange gasket. Water heater pans shall be Holdrite Quick Pan, Oatey, or IPS Corporation.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install water heaters and accessories where shown, in accordance with equipment manufacturer's written instructions and with recognized industry practices. Comply with requirements of state and local codes and applicable NFPA and ASME Boiler and Pressure Vessel Code Standards.
- B. Flush water heaters upon completion of installation in accordance with manufacturer's instructions.
- C. Start-up water heaters in accordance with manufacturer's written procedures, upon completion of heater installation and demonstrate compliance with requirements.
- D. Venting of fuel fired appliances shall be in accordance with manufacturer's requirements and applicable codes and standards.
- E. Condensate from condensing water heaters shall be treated and discharged to the sanitary system in accordance with the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL:

- A. Test assembled water heater and accessories in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

3.3 BALANCING:

- A. Balance the hot water return system(s) to provide the water flowrates required on the drawings. To the greatest extent possible, balance the system using manual balancing valves located at the pump. The Design Professional shall be notified five days in advance of the time when balancing readings will be taken so that he may observe the readings if he so desires. After balancing is complete, submit a typed report indicating the pump identification/ number, manufacturer model number and serial number, verification of proper impeller rotation, design and actual water flow, final design and actual total dynamic head in

psi and ft. hd. for each pump in the system.

END OF SECTION 222210

SECTION 223110 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Industry Standards: Comply with ANSI Standards pertaining to plumbing fixtures and systems.
- B. Comply with ANSI A117.1 standard pertaining to plumbing fixtures for handicapped.
- C. Comply with standards established by Plumbing and Drainage institute (PDI) pertaining to plumbing fixture supports.
- D. Comply with applicable Federal Standard FS WW-P-541/Series sections pertaining to plumbing fixtures.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES:

- A. General: Provide factory-fabricated fixtures of the type, style and material indicated. For each type of fixture, unless otherwise specified, provide fixture manufacturer's standard trim, carrier seats and valves as indicated by their published product information, either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type or manufacturer is indicated, selection is Installer's option.

2.2 MATERIALS:

- A. General: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/series sections pertaining to plumbing fixtures, fittings, trim, metals, and finishes. Comply with requirements of WW-P-541/specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541.
- B. Unless otherwise specified, faucets shall comply with National Sanitation Foundation International NSF Standard 61, and where applicable NSF Standard 61, Section 9. Faucets shall be NSF certified and bear the NSF mark.

- C. Provide materials which have been selected for their surface flatness and smoothness. Exposed surface which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.
- D. Where fittings, trim, and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless-steel units.
- E. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes, and speck; glaze exposed surfaces and test for crazing resistance in accordance with ASTM C 554.
- F. Vitreous China and Enamel Iron Fixtures shall be white unless specified otherwise.
- G. Comply with additional fixture requirements contained in the fixture schedule.
- H. In addition to the manufacturers list below, the following manufacturers are approved for all lavatory, service sink, can wash, and sink faucets: Toto, Kohler, American Standard, Eljer, Chicago, Zurn, T & S Brass, Symmons, Speakman, Elkay and Just.
- I. In addition to the manufacturers list below, the following manufacturers are approved for all vitreous china and cast iron plumbing fixtures: Zurn and Sloan.
- J. Flush valves shall be the size, roughing height, and flow rate specified hereinafter for each fixture. Flush valve shall be piston or diaphragm actuated type with chrome plated exterior, angle stop with cover, vacuum breaker, adjustable tailpiece, and cast escutcheon with setscrew. Where shown on the drawings provide a trap primer connection in the valve tailpiece. All flush valves specified to be 24" roughing shall be provided with wall brace. In addition to the manufacturers list below, Sloan is the preferred flush valve manufacturer.
- K. All low voltage wiring, sensors, and transformers shall be provided under this section with the hardwired flush valves and/or faucets.
- L. Toilet seats shall be same color as fixture. Seats shall be open front without cover, and solid molded plastic with self-sustaining check hinge. Seats shall be for elongated bowl unless specified otherwise. In additions to manufacturers listed below, Beneke shall be an approved manufacturer of toilet seats.
- M. Carriers shall be commercial grade and selected to match the fixtures for which they are used. Carriers shall be floor mounted and designed to transfer any fixture loading to the floor and not the wall unless specified otherwise. Carriers provided for wall hung urinals shall be two plate type. Carriers for wall hung water closets and urinals shall be provided with chrome plated mounting hardware.
- N. Fixture stops shall be provided for all fixtures and shall be chrome plated with cast escutcheons with set screws. Stops for flush valves shall be by the flush valve manufacturer. Stops for shower valves shall be either angle or straight type and shall be concealed behind the shower cover plate. Stops for lavatories and sinks shall be loose key or wheel handle type as specified for each fixture, and stops shall be only from those manufactures listed for each fixture.
- O. Fixture drains shall be by the same manufacturer as the lavatory and sink faucets, with a matching finish. Lavatory and sink drains shall be pop-up, grid, or crumb cup type as

specified for each fixture. Drains shall be chrome plated brass or stainless-steel unless noted otherwise. Drain tailpieces shall be minimum 17-gauge chrome plated cast brass.

- P. All p-traps, continuous wastes and fixture drain piping shall be 17-gauge chrome plated cast brass and of the size indicated in the fixture schedule on the plumbing drawings.
- Q. Insulation kits shall be provided for all handicap lavatories and sinks with exposed supply and waste piping. Insulation kits shall include covers for fixture drains, p-traps and supplies.

2.3 PLUMBING FIXTURE SCHEDULE:

- A. Water Closet P-1A: shall be a floor mounted, floor outlet, vitreous china, siphon jet water closet with elongated bowl (designed for 1.28 gallon flush), 1-1/2" top spud, floor bolts, bolt caps, and outlet gasket. The water closet shall be fitted with a white seat and 1-1/2" (11-1/2" roughing) flush valve. Flush valve shall be a hardwired infrared operated type with unpowered manual override and chrome plated exterior. Water closet and trim shall be:

	American Std.	Kohler	Zurn
	Madera	Wellcomme	
Water Closet:	2234.001	K-96054	Z5655
Flush Valve:	American Std.	Sloan	Zurn
Seat:	Plumbtech	Bemis	Zurn

- B. Urinal P-2A: shall be a wall hung (nominal 27" x 18" x 14" deep), vitreous china, washout urinal (designed for 0.125 gallon flush), 2" outlet, 3/4" top spud and wall hangers. The urinal shall be fitted with a 3/4" (11-1/2" roughing) flush valve and back plate. Flush valve shall be a hardwired infrared operated type with unpowered manual override and chrome plated exterior. Urinal shall be:

	American Std.	Kohler	Zurn
	Washbrook	Bardon	
Urinal:	6590.525	K-4904	Z5755
Flush Valve:	American Std.	Sloan	Zurn

- C. Lavatory P-3A: Provided by others.

- D. Lavatory P-3B: shall be a wall hung, 20"x18" vitreous china lavatory with back splash and punched for 4" centers. The lavatory shall be fitted with a chrome plated ADA compliant center-set faucet with single lever handle and low flow aerator (0.5 gpm), off-set perforated grid drain, 1-1/4" p-trap, loose key angle supplies, chair carrier with concealed arm supports and insulation kit. Lavatory and trim shall be:

	American Std.	Kohler	Crane
Lavatory:	Lucerne	Greenwich	Harwich
	0355.012	K-2032	1412V
Faucet:	Chicago	Zurn	T & S Brass
	2200-4ABCP	Z81000-XL	B-2711
Drain:	Mcguire	Zurn	Watts
P-trap:	Mcguire	Zurn	Watts
Supplies:	Mcguire	Zurn	Watts

Insulation Kit:	Mcguire	Truebro	Skal-Guard
Carrier:	J.R. Smith	Josam	Zurn

- E. Mop Sink P-4: shall be a 24"x24" molded stone mop basin with 10" high sides and integral 3" chrome plated dome drain. The mop sink shall be fitted with vinyl bumper guards, a chrome plated faucet with vacuum breaker, a hose with hose bracket, and stainless steel wall guards. Mop sink shall be white and the faucet shall be mounted on the wall 36 inches above the floor. Mop basin shall be:

	Fiat	Swan	Zurn
Basin:	MSB 2424	MS 2424-3	Z-1996-24
Bumper Guards:	E-77-AA	MS-2408	BV
Faucet:	830-AA	MS-5811	Z843M1-XL
Hose/Bracket:	832-AA	MS-2405	HH
Wall Guards:	MSG2424		WG

- F. Break Room Sink P-5: shall be an 18-gauge, type 302 stainless-steel, ADA, self-rimming sink with 21"x19"x6-1/2" deep overall dimensions, single bowl with underside sound deadened. The sink shall be fitted with a chrome plated single lever ADA compliant faucet and low flow aerator (1.5 gpm), offset crumb cup drain, 1-1/2" p-trap, loose key angle supplies, 3/4 HP garbage disposer with cord and plug garbage disposer with cord and plug (maximum 11-3/8" high), and insulation kit. Sink and trim shall be:

Sink:	Just	Elkay	Advance Tabco
	SL-ADA-1921-AGR	LRAD221965	Equivalent
Faucet:	J-900	LK1000CR	Speakman S-3762-E
Drain:	Mcguire	Zurn	Watts
P-Trap:	Mcguire	Zurn	Watts
Supplies:	Mcguire	Zurn	Watts
Insulation Kit:	Mcguire	Truebro	Skal-Guard
Garbage Disp.:	In Sink-Erator Model 555ss, or equal		

- G. Ice Maker Box P-6: shall be a recessed flush mounting plastic or painted steel box with 1/4 turn cold water angle valve and water hammer arrestor. Ice maker box shall be:

Oatey	Guy Gray	Water Tite
38490	MIB1HA	W9700 HA

- H. Condensate Drain Box P-7: shall be a recessed flush mounting stainless steel box with plugged 2" drain outlet. Box shall have a 1" wall flange, door with continuous piano hinge and cylinder lock, and 1" high water dam. Box shall be approved for installation in rated walls (if applicable). Condensate Drain Box shall be Acorn M8200-E501-003, Guy Gray, or Oatey.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install plumbing fixtures of types indicated where shown and at indicated heights or where

not shown in accordance with manufacturer's written instruction, roughing-in drawings and with recognized industry practices.

- B. Install all low voltage wiring, sensors, and transformers furnished with the hardwired flush valves and/or faucets. 120V power connections for the low voltage transformers shall be connected by the Division 26 contractor in accordance with specification section 261010. All low voltage wiring and needed pathways shall be provided under this section. Provide needed pathway/chase to form an accessible pathway from each sensor location to a point within 6" of low voltage transformer and terminate with insulated throat bushing. Wiring installed in an open plumbing chase can be installed without conduit.
- C. Fasten plumbing fixtures securely to indicated supports or building structure and ensure that fixtures are level and plumb and tight against mounting surface.
- D. Seal the outer perimeter of wall mounted lavatories and urinals and water closets to the wall and floor mounted water closets to the floor with a smooth bead of white silicone compound.
- E. All fixtures provided under another division of the specifications shall be roughed-in and connected under this section. Provide individual shut-off valves or supply stops to all fixtures with a water or gas supply. Provide p-traps and extensions to waste stack in wall or to drain, as shown on the drawings, if not provided by the fixture supplier. Supply stops and p-traps shall be Mcguire, EBC, or Brass-Craft.
- F. Provide and install undercounter mixing valves for all sinks and lavatories except those in commercial kitchens.
- G. Metering faucets shall have a minimum run time of (10) seconds and a maximum run time of (30) seconds.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test and adjust fixtures for proper operation.

END OF SECTION 223110

SECTION 223210 – ELECTRIC WATER COOLERS AND DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Provide drinking-water coolers which have been listed and labeled by Underwriters' Laboratories (UL399).
2. Provide drinking-water coolers which are rated and certified in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 1010.
3. Provide wheelchair water coolers which comply with ANSI A117.1 and ADA guidelines.
4. Provide drinking-water coolers which are manufactured using lead-free components and solder in all waterways.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties as applicable.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER COOLER “EWC-1”:

- A. Provide modular bi-level wall mounted unit with recessed refrigeration system. The unit shall be ADA compliant and have a heavy gauge galvanized steel wall mounting frame, stainless steel basins with bottom covers, and stainless-steel wall cover plate(s). The refrigeration system shall be hermetically sealed with 120V/1Ph/60Hz compressor and air-cooled condenser. The unit shall deliver a minimum of 8 gph of 50 F water at 90 F ambient and 80 F entering water temperatures. Each basin shall have a chrome plated brass drain with removable strainer, and self-closing push button/bar. The water cooler shall be fitted with (2) cast brass p-traps, a valved 1/2" cold water supply, and a NEMA 5-20P rated plug with 3' (min.) cord. Provide with refrigerated integral sensor operated bottle filler accessory. Unit shall be Halsey-Taylor OVL-II or equivalent by Oasis, Murdock, or Elkay.

PART 3 - EXECUTION

3.1 INSTALLATION:

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR-82-2001
PERMIT SUBMITTAL
APRIL 2024

223210 - 1

- A. General: Install water coolers in accordance with manufacturer's written instructions and in accordance with the National Electrical Code and recognized industry practices.
- B. After water coolers are mounted on wall, bolt a 1-1/2" steel angle bracket to bottom of unit and attach to wall. Paint to match wall.

3.2 FIELD QUALITY CONTROL:

- A. Test operates installed water coolers to demonstrate compliance with the requirements.

END OF SECTION 223210

SECTION 230110 – MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.
- B. It is recognized that separate sub-contracts may be instituted by THIS CONTRACT'S GENERAL CONTRACTOR with others. It is the responsibility of THIS CONTRACT'S GENERAL CONTRACTOR to completely inform, coordinate, and advise those sub-contractors of the requirements, conditions, and information associated with providing and installing their portion of the total job.
- C. This project will comply with the requirements of *Georgia Peach* certification and will be commissioned by a third party CxA. Refer to Division 01 for specific system commissioning support required from the contractor.

1.2 IMPOSED REGULATIONS:

- A. Applicable provisions of the State and Local Codes and of the following codes and standards in addition to those listed elsewhere in the specifications are hereby imposed on a general basis for mechanical work. In each case, the prevailing edition shall be the current adopted edition of the state where the project is located.
 - 1. *International Mechanical Code.*
 - 2. *International Gas Code.*
 - 3. *International Energy Conservation Code.*
 - 4. *International Fire Code.*

1.3 SCOPE OF WORK:

- A. Provide all labor, materials, equipment, and supervision to construct complete and operable mechanical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged, and free from any defects.

1.4 EXISTING SERVICES AND FACILITIES:

- A. **Damage to Existing Services:** Existing services and facilities damaged by the Contractor through negligence or through use of faulty materials or workmanship shall be promptly repaired, replaced, or otherwise restored to previous conditions by the Contractor without additional cost to the Owner.
- B. **Interruption of Services:** Interruptions of services necessary for connection to or modification of existing systems or facilities shall occur only at prearranged times approved by the Owner. Interruptions shall only occur after the provision of all temporary work and the availability of

adequate labor and materials will assure that the duration of the interruption will not exceed the time agreed upon.

- C. Removed Materials: Existing materials made unnecessary by the new installation shall be removed, shall remain the property of the Owner and shall be stored at a location and in a manner as directed, or, if classified by the Owner's authorized representative as unsuitable for further use, shall become the property of the Contractor and shall be removed from the site.

1.5 WARRANTIES:

- A. Provide manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Where the warranty requirements of a specific specification section exceed the manufacturer's standard warranty, the more stringent requirements will apply, and modified manufacturer's warranty shall be provided. The Contractor shall provide a (2) year warranty on all parts and labor. The warranty shall begin at the Material Completion date.

1.6 PRODUCT SUBSTITUTIONS:

- A. General: Materials specified by manufacturer's name shall be used unless prior approval of an alternate is given by addenda. Requests for substitutions must be received in the office of the Design Professional at least (10) days prior to opening of bids.

PART 2 - PRODUCTS

2.1 GENERAL MECHANICAL PRODUCT REQUIREMENTS:

- A. Standard Products: Provide not less (quality) than manufacturer's standard products, as specified by their published product data. In addition to the indication that a particular product/model number is acceptable, comply with the specified requirements. Do not assume that the available off-the-shelf condition of a product complies with the requirements; as an example, a specific finish or color may be required.
- B. Uniformity: Where multiple units of a general product are required for the mechanical work, provide identical products by the same manufacturer, without variations except for sizes and similar variations as indicated.
- C. Product Compatibility, Options: Where more than one product selection is specified, either generically or proprietarily, selection is Purchaser's or Installer's option. Provide mechanical adaptations as needed for interfacing of selected products in the work.
- D. Equipment Nameplates: Provide a permanent operational data nameplate on each item of power operated mechanical equipment, indicating the manufacturer, product name, model number, serial number, speed, capacity, power characteristics, labels of tested compliance, and similar essential operating data.

- E. Locate nameplates in easy-to-read locations. When product is visually exposed in an occupied area of the building, locate nameplate in a concealed position (where possible) which is accessible for reading by service personnel.

PART 3 - EXECUTION

3.1 PRODUCT INSTALLATION, GENERAL:

- A. Except where more stringent requirements are indicated, comply with the product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing, charging, lubrication, startup, test operation and shut down of operating equipment. Consult with manufacturer's technical experts, for specific instructions on unique product conditions and unforeseen problems.
- B. Protection and Identification: Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identifications; adequately packaged or protected to prevent deterioration during shipment, storage, and handling. Store in a dry, well ventilated, indoor space, except where prepared and protected by the manufacturer specifically for exterior storage.
- C. Permits and Tests: Provide labor, material, and equipment to perform all tests required by the governing agencies and submit a record of all tests to the Owner or authorized representative. Notify the Design Professional five days in advance of any testing.
- D. Locate all equipment such that sufficient space is left to allow unrestricted access for service or repair.

END OF SECTION 230110

SECTION 230120 - MECHANICAL STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Industry Standards: It is a general requirement that mechanical work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to the extent more detailed and stringent requirements are indicated or required by governing regulations.

- B. Listing of Associations, Standards, and Abbreviations:

1. *AGA* *American Gas Association*
1515 Wilson Blvd.
Arlington, VA 22209
2. *AMCA* *Air Movement & Control Association*
30 W. University Dr., Arlington Heights, IL 60004
3. *ARI* *Air-Conditioning and Refrigeration Institute*
4301 North Fairfax Drive, Suite 425, Arlington, VA 22203
4. *ASHRAE* *American Society of Heating, Refrigerating & Air Conditioning Engineers, Inc.*
1791 Tullie Circle, NE, Atlanta, GA. 30329
5. *AWS* *American Welding Society, Inc.*
2501 NW 7th St., Miami, FL 33125
6. *CISPI* *Cast Iron Soil Pipe Institute*
2020 K. St., NW, Washington, DC
7. *NEBB* *National Environmental Balancing Bureau*
1611 North Kent St.,
Arlington, VA 22209
8. *NEC* *National Electrical Code by NFPA*
9. *NEMA* *National Electrical Manufacturers Association*
1300 N 17th Street, Suite 1847
Rosslyn, VA 22209
10. *NFPA* *National Fire Protection Association*
407 Atlantic Ave.,
Boston, MA 02210
11. *SMACNA* *Sheet Metal & Air Conditioning Contractors National Association, Inc.*
8224 Old Courthouse Rd., Tysons Corner
Vienna, VA 22180
12. *TIMA* *Thermal Insulation Manufacturers Association*
7 Kirby Plaza
Mt. Kisco, NY 10549

13. *UL*

Underwriters' Laboratories, Inc.
207 East Ohio St.,
Chicago, IL 60611

PART 2 AND 3 - PRODUCTS AND EXECUTION

A. Not applicable.

END OF SECTION 230120

SECTION 230210 - MECHANICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Mechanical Coordination Plans: Prepare a set of coordination plans showing the coordination of the major elements, components, and systems of the mechanical work, and showing the coordination of mechanical work with other work. Prepare plans at accurate scale and sufficiently large to show locations of every item, including clearances for installing, maintaining, insulating, breaking down equipment, replacing motors and similar requirements. Prepare plans to include plans, elevations, sections, and details as needed to conclusively show successful coordination and integration of the work. Submit plans for review by the Design Professional. Coordination plans shall be submitted for the following areas: All mechanical equipment rooms.
- B. Coordinate the actual location of all mechanical work visible in finished spaces with the Design Professional. This includes air distribution devices, exposed ductwork, thermostats, humidistats, switches, sensors, etc.
- C. Mechanical Coordination Affidavit: Prior to ordering materials, provide the Coordination Affidavit required by Section 230220.

PART 2 - PRODUCTS

2.1 MECHANICAL PRODUCT COORDINATION:

- A. Power Characteristics: Refer to the electrical sections of the specifications and the electrical drawings for the power characteristics available for the operation of each power-driven item of equipment. The electrical design was based on the typical power requirements of the equipment manufacturers scheduled or specified. Any modifications to the electrical system which are required due to the use of an approved equivalent manufacturer shall be made at no additional cost to the owner. All changes must be clearly documented and submitted for review by the Design Professional prior to purchasing equipment. Coordinate purchases to ensure uniform interface with electrical work. The mechanical contractor shall furnish a detailed list of equipment electrical characteristics to the electrical contractor for the purpose of preparing the coordination affidavit required by Division 26.
- B. [Filters: Disposable HVAC filter shall conform to SCCPSS approved sizes. Contact SCCPSS Facility Department for approved list.]

- C. Coordination of Options and Substitutions: Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface of equipment has been checked and satisfactorily established.
- D. Firestopping: Refer to architectural drawings for the locations of all fire rated ceilings, floors, and walls. The contractor shall furnish detailed shop drawings of all firestopping details to be used for both piping and ductwork. All firestopping details shall be U.L. listed and subject to approval by the State Fire Marshal.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

- A. Substrate Examination: The Installer of each element of the mechanical work must examine the condition of the substrate to receive the work, and the conditions under which the work will be performed and must notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Do not proceed with the installation of sleeves, anchors, hangers, roof penetrations and similar work until mechanical coordination drawings have been processed and released for construction. Where work must be installed prior to that time to avoid a project delay, review proposed installation in a project coordination meeting including all parties involved with the interfacing of the work.

3.2 CUTTING AND PATCHING:

- A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Design professional written authorization.
- B. Where authorized, cut opening through concrete (for pipe penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.
- C. Other work: Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work. Review the proposed cutting with the Installer of the work to be cut and comply with recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.
- D. Where patching is required to restore other work, because of either cutting or other damage inflicted during the installation of mechanical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finishes, as judged by the Design Professional. Engage the original Installer to complete patching of the following categories of work:
 - 1. Exposed concrete finishes and exposed masonry.
 - 2. Waterproofing and vapor barriers.
 - 3. Roofing, flashing and accessories.

4. Interior exposed finishes and casework, where judged by the Design Professional to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF MECHANICAL INSTALLATION:

- A. General: Sequence, coordinate and integrate the various elements of mechanical work so that the mechanical plant will perform as indicated and be in harmony with the other work of the building. The Design Professional will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:
 1. Install piping, ductwork, and similar services straight and true, aligned with other work and with overhead structures and allowing for insulation. Conceal where possible.
 2. Arrange work to facilitate ease of maintenance and repair or replacement of equipment and filters. Locate items requiring more maintenance such as valves, etc. in front of items requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.
 3. Equipment located above ceilings shall be installed in a position and elevation which allows complete and adequate maintenance access through the ceiling grid or access panel while standing safely on a ladder. If this is not possible, a suitable maintenance platform must be provided per IMC.
 4. Give the right-of way to piping systems required to slope for drainage (over other service lines). Piping shall be located to avoid interference with ductwork and light fixtures.
 5. Store materials off the ground and protected from standing water and weather.
- B. Drawings: Conform with the arrangement indicated by the contract documents to the greatest extent possible, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Design Professional's decision on resolution of the conflict.
- C. Electrical Work: Coordinate the mechanical work with electrical work, and properly interface with the electrical service. In general, and except as otherwise indicated, install mechanical equipment ready for electrical connection. Refer to electrical sections of the specifications for electrical connection of mechanical equipment.
- D. Duct Smoke Detectors: In buildings equipped with a fire alarm system, all HVAC duct smoke detectors, including smoke detectors for smoke dampers, shall be furnished by Division 26 and installed by Division 23. All duct smoke detectors must be compatible with the fire alarm system and must be connected to the fire alarm system for notification. All fire alarm wiring and associated devices shall be furnished and installed by the fire alarm system installer. In buildings not equipped with a fire alarm system, all HVAC duct smoke detectors and accessories shall be furnished and installed by Division 23. Each duct smoke detector must have a remote device where actuation of the duct smoke detector shall activate a visible and an audible signal in an approved location. Duct smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as "Air Duct Detector Trouble." Each smoke detector shall be wired into the respective fan control circuit to automatically shut down the fan upon sensing products of combustion.
- E. Utility Connections: Coordinate the connection of mechanical systems with exterior underground utilities and services. Comply with the requirements of governing regulations, franchised service companies and controlling agencies. Provide a single connection for each service except where multiple connections are indicated.

3.4 COORDINATION OF MECHANICAL STARTUP:

- A. Seasonal Requirements: Adjust and coordinate the timing of mechanical system start-ups with seasonal variations, so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off-season start-ups to ensure that systems and equipment will not be damaged by the operation.

- B. Painting and Air Distribution: Coordinate the initial cleaning and start-up of the air distribution system, to occur prior to preparatory cleaning and general interior painting and decorating on the project. The HVAC system should not be operated until drywall work is completed. Drywall dust must not be allowed to contaminate the interior of air handling units and ductwork. Use high efficiency temporary filters until project closeout.

END OF SECTION 230210

SECTION 230220 - MECHANICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTAL FORMS AND PROCEDURES:

- A. The purpose of submittals is to demonstrate to the Design Professional that the Contractor understands the design concept. The Design Professional's review of such drawings, schedules, or cuts shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless he has, in writing, called the Design Professional's attention to such deviations at the time of submission, and has received from the Design Professional, in writing, permission for such deviations. All submittals must be completely checked by the Contractor prior to submission for review.
- B. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders, arranged, and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 23 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.
- C. Electronic Submittals: All electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 23 Superintendent's name, Suppliers and point of contact for each, and date.
- D. Submittals shall be made for all items contained in the Mechanical Submittal List in PART 3 - EXECUTION.
- E. Response to Submittals: A Mechanical Submittal Review Report shall be issued by the Engineer with the following classifications for each item:
 - 1. **"No Exceptions Taken"**: No corrections, no marks. Contractor shall submit copies for distribution.
 - 2. **"Make Corrections Noted"**: A few minor corrections. Items may be ordered as marked up without further resubmission. Submit copies for distribution.
 - 3. **"Revise and Resubmit"**: Minor corrections. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
 - 4. **"Rejected"**: Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.

PART 2 - PRODUCTS

2.1 SUBMITTAL REQUIREMENTS:

- A. General: Each specification section shall list the required submittal items. All submittal items shall conform to the requirements listed below. For each major section of submittal data, include a summary page which lists items and model numbers for each piece of equipment.
- B. Shop Drawings: Prepare mechanical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment. Show piping connections and other service connections and show interface with other work including structural support. Indicate by note, the portions of mechanical work shown on the shop drawings which deviated from the indication of work in the contract documents and explain the reasons for the deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of the work, currently or previously submitted.
- C. Manufacturer's Data: Where pre-printed data is submitted for more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided. Delete or mark-out significant portions of preprinted data which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. Expansion or elaboration of standard data to describe a non-standard product must be processed as a shop drawing submittal. For each product include the manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating capacities, piping and service line connection sizes and locations, statements of compliance with required standards and governing regulation (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with the requirements.
- D. ATTACHMENT NO. 1 (Mechanical Coordination Affidavit):
 - 1. The intent of Attachment Number 1 is to ensure that the electrical requirements for mechanical equipment have been reviewed and coordinated by the Contractor. No mechanical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

PART 3 - EXECUTION

3.1 MECHANICAL SUBMITTAL LIST:

- 23 0210 – Mechanical Coordination:
 - Mechanical Coordination Plans.
 - Mechanical Coordination Affidavit (see Attachment No. 1 below)

- 23 0230 – Mechanical Identification:
 - Pipe Markers.
 - Pipe Tape.
 - Engraved Nameplates.
 - Valve Tags.
 - Valve Charts.

- 23 0240 – Mechanical Work Closeout:
 - Record Plans.
 - Maintenance Manuals.
 - Mechanical TAB Report.
 - Owner Training Videos.

- 23 0310 – Mechanical Pipe, Tube, and Fittings:
 - Black Steel Pipe, Schedule 40.
 - Copper Tube.
 - PVC Pipe.
 - Cast Iron Threaded Fittings.
 - Cast Iron Flanged Fittings.
 - Gasket for Flanged Joints.
 - Soldering Materials.
 - Mechanical Couplings.
 - PVC Cement.
 - Pipe Sleeves.
 - Fire Caulk.
 - Latex Paint for PVC Pipe.

- 23 0320 – Mechanical Hangers and Supports:
 - Refrigerant Pipe Hangers.
 - Chilled Water Pipe Hangers (Clevis Type).
 - HVAC Drain Pipe Hangers (Clevis Type).
 - Pipe Supports, Guides, Shields, and Saddles.

- 23 1110 – Mechanical Water Piping System:
 - Underground Preinsulated Pipe.
 - Shutoff Valves.
 - Check Valves.
 - Drain Valves.
 - Manual Balancing Valves.
 - Automatic Balancing Valves.
 - Hose Kits.
 - Pressure Reducing Valves.
 - Pressure Relief Valves.
 - Wye Strainers.
 - Air Separators.
 - Expansion Tanks.
 - Chilled Water Storage Tanks.
 - Flexible Hoses.
 - Automatic Air Vents.
 - Manual Air Vents.

- Flow Metering Stations.
- Thermometers.
- Pressure Gauges.
- Heat Trace Tape.
- Underground Steel Pipe Protection.
- Painting.

- 23 1210 – Mechanical Piping and Equipment Insulation:
 - Fiberglass Insulation and Fittings.
 - Cellular Glass Insulation and Fittings.
 - Closed Cell Elastomeric Insulation and Fittings.
 - Polystyrene Insulation and Fittings.
 - Aluminum Jackets.

- 23 1310 – Pumps:
 - All equipment in PUMP SCHEDULE and/or plans and/or specifications.

- 23 1410 – Water Treatment:
 - Chilled Water System.
 - Mechanical Room Plans and Piping Diagrams.

- 23 2110 – Ductwork:
 - Duct Construction Standards.
 - Galvanized Steel Ducts.
 - Double Wall Round Spiral Seam Ducts and Fittings.
 - Flexible Ducts.
 - Fabric Ducts.
 - Flexible Connectors.
 - Manual Balancing Dampers.
 - Round Takeoff Fittings.
 - Rectangular Takeoff Fittings.
 - Fire Dampers.
 - Duct Access Doors.
 - Flexible Duct Elbow Support.
 - Duct Wrap Type ‘A’.
 - Duct Liner Type ‘A’.
 - Duct Insulation Accessories.
 - Duct Insulation Compounds.
 - Duct Sealant.
 - Duct Leakage Test Results.

- 23 2210 – Air Distribution:
 - All devices in AIR DISTRIBUTION SCHEDULE and/or plans and/or specifications.

- 23 2310 – Fans:
 - All equipment in FAN SCHEDULE and/or plans and/or specifications.

- 23 2410 – Air Handling Units:
 - All equipment in AIR HANDLING UNIT SCHEDULE and/or plans and/or specifications.

- 23 2420 – Terminal Units:

- All equipment in TERMINAL UNIT SCHEDULE and/or plans and/or specifications.
- 23 2430 – Fan Coil Units:
All equipment in FAN COIL UNIT SCHEDULE and/or plans and/or specifications.
- 23 3110 – Electric Heaters:
All equipment in ELECTRIC HEATER SCHEDULE and/or plans and/or specifications.
- 23 4110 – Air-Cooled Chillers:
All equipment in AIR-COOLED CHILLER SCHEDULE and/or plans and/or specifications.
- 23 4320 – Air Treatment Systems:
All equipment in noted in equipment schedules and/or plans and/or specifications.
- 23 6110 – Heat Pumps:
All equipment in HEAT PUMP SCHEDULES and/or plans and/or specifications.
- 23 7310 –Humidifiers:
All equipment in HUMIDIFIER SCHEDULE and/or plans and/or specifications.
- 23 7410 –Dehumidifiers:
All equipment in DEHUMIDIFIER SCHEDULE and/or plans and/or specifications.
- 23 8310 – EMCS (Energy Management Control System):
All controls equipment, sequences, control diagrams, etc. in plans and/or specifications.
- 23 9110 – Mechanical Sound, Vibration, Wind, and Seismic Control:
Wind Calculations for all roof mounted equipment.
All equipment in plans and/or specifications.
- 23 9210 – Mechanical TAB (Test, Adjust, Balance):
Qualifications package.
Testing procedures.
Instrument list.
Sample test forms.

END OF SECTION 230220

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 23 Superintendent, certify that I have reviewed the mechanical shop drawings for electrically driven equipment and that the accompanying mechanical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. In addition, the electrical requirements of said equipment have been coordinated with the Division 26 contractor.

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY: _____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____ DATE: _____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

SECTION 230230 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in the manufacture of identification systems required for this product.
- B. Submittals: Submit manufacturer's data on materials and submit a sample of each type required.

PART 2 - PRODUCTS

2.1 MECHANICAL IDENTIFICATION MATERIALS:

A. Pipe Markers:

1. General: Product manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
2. Small Pipe: For external diameters less than 6" (including insulation, if any), provide full band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap.
 - c. Laminated or bonded application of pipe marker to pipe (or insulation).
 - d. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
3. Large Pipes: For external diameters of 6" and larger (including insulation, if any), provide either full-band or strip-type pipe markers, but not narrower than 3 x letter height (and of required length), fastened by one of the following methods:
 - a. Laminated or bonded application of pipe marker to pipe (insulation).
 - b. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide: full circle at both ends of pipe marker, tape lapped 3".
4. Lettering: Comply with piping system names as specified, scheduled, or shown, and abbreviate only as necessary for each application length.
5. Arrows: Print each pipe marker with arrow indicating direction of flow, either integrally with piping system service lettering or as separate unit of plastic (to accommodate both directions).
6. Install pipe markers on the following systems:
 - a. Chilled Water Supply and Return Piping
 - b. Refrigerant Piping

c. HVAC Drain Piping

- B. Pipe Tape: Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
1. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters including insulation of less than 6", and 2-1/2" wide tape on larger pipes.
 2. Color: Comply with ANSI A13.1.

C. Engraved Plastic-Laminate Labels:

1. General: Provide engraving stock melamine plastic laminated, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core, letter color, except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16", except as otherwise indicated.
3. Fasteners: Self-tapping stainless-steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
4. Install engraved equipment labels on all mechanical equipment. Match equipment names as scheduled.

D. Valve Tags:

1. Valve tags shall be 18-gauge (minimum) brass with 1-1/4" (minimum) height and width. Identification letters and numbers shall be stamped in tag and shall be filled with black paint.
2. Valve tags shall be attached to valve using cable ties. Cable ties shall be self-locking nylon ties.
3. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tag shape and designations shall be as follows:

<u>Identification System</u>	<u>Shape</u>	<u>Numbers</u>
Chilled Water	Round	CH-1, 2, 3, ...

E. Valve Charts:

1. Valve charts shall be provided for mechanical systems. Charts shall be located in each mechanical room.
2. Valve charts shall be typed listing all valve tags. List shall include identification number, valve location in system (e.g., Corridor 123, Chilled Water Pump CWP-1, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Charts shall be mounted in an aluminum frame with plastic cover.

2.2 LETTERING AND GRAPHICS:

- A. General: Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified, or scheduled. Provide numbers, lettering recommended by manufacturers or as required for proper identifications and operation/maintenance of the mechanical systems and equipment.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting and other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering or painting.
- B. All equipment, dampers, filters, valves, etc. located above ceiling grids shall be located with an engraved marker permanently attached to the ceiling grid. The marker shall describe the item located above the ceiling.
- C. Piping System Identification: Install pipe markers on each system indicated to receive identification and include arrows to show normal direction of flow.
- D. Locate pipe markers as follows wherever piping is exposed to view in mechanical rooms, accessible maintenance spaces (including accessible areas above ceilings) and exterior non-concealed locations:
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures. Mark each pipe at branch, where there could be a question of flow pattern.
 - 3. Near locations where pipes pass through walls or ceilings or enter non-accessible enclosures.
 - 4. Near major equipment items and other points of origination and termination.
 - 5. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
- E. Do not mark piping exposed in finished occupied spaces.
- F. Mechanical Equipment Identification: Install an engraved plastic laminate label on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Each label shall include the equipment name, room number and electrical panel name. Confirm installed final room numbers and electrical panel names prior to ordering labels.
- G. Valve tags shall be attached to the valve handwheel with cable ties.

END OF SECTION 230230

SECTION 230240 - MECHANICAL WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DOCUMENTATION PROCEDURES:

- A. Signed Commitments: Do not proceed with transfer of mechanical plant to the Owner for operation until warranties, performance certifications and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Design Professional (for Owner's records).

PART 2 – PRODUCTS

2.1 RECORD PLANS:

- A. Explanation: Except where otherwise indicated, mechanical plans (contract plans) prepared by Engineer are diagrammatic in nature and may not show locations accurately for various components of mechanical systems. Shop drawings, including coordination plans, prepared by Contractor shall show certain portions of work more accurately to scale and location, and in greater detail.
- B. General Recording Procedure: Maintain a white-print set, blue-line or black-line, of mechanical contract plans and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever plans are most capable of showing the installed conditions accurately; however, where shop drawings are marked, record a reference note on appropriate contract drawing. Mark with erasable pencil and use multiple colors to aid in the distinction between work of separate mechanical systems. In general, record every substantive installation of mechanical work which previously is either not shown or shown inaccurately, but in any case record the following:
 - 1. Underground and aboveground piping, both exterior and interior, drawn to scale and fully dimensioned.
 - 2. *"Mechanical Project Record"* shall be maintained as part of the *"Project Record"* specified in Division 1.

2.2 MAINTENANCE MANUALS:

- A. Organize each copy of the required system maintenance manuals to include an index followed by thumb-tab marked sections for each of the following:
 - 1. Operating Instructions: Submit manufacturer's operating instructions for each item of

mechanical equipment and supplement with additional project application instructions where necessary. Prepare and submit specific operating instructions for charging, start-up, control or sequencing of operation, phase, or seasonal variations, shut-down, safety and similar operational instructions. Prepare in typewritten form in completely explained and easily understood English language

2. Emergency instructions including addresses and telephone numbers of service sources.
 3. Regular system maintenance procedures including lubrication.
 4. List of all filters required for each unit.
 5. Spare parts listing and stocking recommendations.
 6. Inspection, adjusting, rebalancing, cleaning, parts replacement, and similar maintenance instructions and recommendations, including the proper use of tools and accessories.
 7. Valve schedule and control diagram for each system.
 8. Manufacturer's data and test reports for each operating item in each system.
 9. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
 10. Corrected or approved issues of submittal items relating to the system.
- B. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binder, plus pocket-folder type binders for folded drawings, and mark the back spine of each binder with system identification and volume number.
- C. Certifications: Where specifically indicated, submit with notarized execution.
- D. Test Reports: Submit test reports which have been signed and dated by the firm performing the test and prepared in the manner specified in the standard or regulation governing the test procedures as indicated.
- E. Manufacturer's Product Warranties: Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by the Design Professional or Engineer), product is automatically disqualified from use on the project, except where manufacturer prepares and issues a specific product warranty on the product, stating that it is in lieu of the published warranty, and is executed by an authorized officer, and complies with the requirements. Warranties shall comply with the requirements of individual specification section where those requirements exceed the manufacturer's standard warranty.
- F. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal

2.3 MECHANICAL TEST, ADJUST, BALANCE REPORT:

- A. See Section 239210.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

- A. General Coordination: Sequence closeout procedures properly, so that work will not be

endangered or damaged, and so that every required performance will be fully tested and demonstrated.

- B. System Performance Test Run: At the time of mechanical work closeout, check each item in each system to determine that it is set for proper operation. With Owner's representative and Design Professional present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of system to refine and improve performances wherever possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Design Professional's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Test run shall be scheduled to coincide with Design Professional's final inspection of the mechanical work.
- C. Cleaning and Lubrication: After final performance test run of each mechanical system, clean system both externally and internally. Clean dirt and debris from air handling systems and install new filters. Flush piping system by operating drains and similar means, and clean strainers and traps. Lubricate both power and hand operated equipment and remove excess lubrication. Touch-up minor damage to factory painted finishes and other painting specified as mechanical work; refinish work where damage is extensive.
- D. General Operating Instructions: In addition to specified training of Owner's operating personnel specified in individual mechanical sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified, provide general operating instructions for the total mechanical plant. Conduct a walk-through explanation and demonstration for orientation and education of Owner's personnel to be involved in continued operation of building and its mechanical plant.
 - 1. Describe each basic mechanical system and how its control system functions, including flow adjustments, temperature control and similar operations.
 - 2. Explain and point out identification system, displayed diagrams, signals, alarms and similar provisions of the work.
 - 3. Describe basic sequencing requirements and interlock provisions for system start-up, phasing, coast-down, shut-down, and seasonal operations.
 - 4. Emphasize emergency procedures and safety provisions for protection of equipment and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances, and describe system limitations and precautions including weather adjustments.
 - 5. Outline basic maintenance procedures.
- E. Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption and similar performance improvements.
- F. Point out operational security provisions, safety, unavoidable hazards, and similar operator limitations. Display and conduct a "thumb-through" explanation of maintenance manuals, record drawings, meter readings and similar service items.
- G. All training sessions shall be digitally recorded (audio/video) and submitted to the Owner.
- H. Construction Equipment: After completion of performance testing and Owner's operating

instructions and demonstrations, remove installers tools, test facilities, construction equipment and similar devices and materials used in execution of the work but not incorporated in the work.

3.2 CONTINUED SYSTEM OPERATIONS:

- A. Final Acceptance: At time of material completion of mechanical work, Owner's operating personnel will take over operation of mechanical systems. However, until time of final acceptance, respond promptly with consultation and services on whatever operation or maintenance problems may remain or arise in continued operation of mechanical plant.

END OF SECTION 230240

SECTION 230310 – MECHANICAL PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Qualify welding procedures, welders, and operators in accordance with ASME B31.1 for shop and project site welding of piping work.
2. Certify welding of piping work using the *Standard Procedure Specifications* by, and welders tested under supervision of, the *National Certified Pipe Welding Bureau*.
3. Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing approval label by the *National Sanitation Foundation* (NSF).

B. Submittals:

1. Submit manufacturer's data, welding certifications, test reports, and product warranties as applicable for all piping materials.
2. Grooved joint couplings and fittings and press joint fittings shall be shown on drawings and product submittals and be specifically identified with the applicable style number.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Provide pipe and tube of the type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements and comply with governing regulations and industry standards.

- B. Black Steel Pipe: *ASTM A 53*, Schedule 40.

- C. Copper Tube: *ASTM B88* Type L as indicated for each service; hard drawn temper, except as otherwise indicated. Soft copper tubing may be used for ACR piping 3/4" and smaller from heat recovery controllers to air handlers.

D. Plastic Pipe:

1. PVC-WATER: *ASTM D2466-88*:

2.2 PIPE/TUBE FITTINGS:

- A. General: Provide factory-fabricated fittings of the type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube valve or equipment connections in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.
- B. Cast-Iron Flanged Fittings for Steel Pipe: *ASME B16.1*, including bolting. Class 125, plain or galvanized to match pipe.
- C. Gaskets for Flanged Joints: *ASME B16.21*; full-faced for cast-iron flanges.
- D. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.
 - 1. Tin-Antimony Solder: *ASTM B 32*, Grade 95TA.
- E. Mechanical Couplings for IPS Pipe: Coupling housings shall be ductile iron (*ASTM A536*). Bolts and nuts shall be carbon steel track-type (*ASTM A183*), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM, for water services from -30 F to 230 F. At joints allowing controlled movement, expansion, contraction or deflection, flexible couplings shall be used. At all joints not requiring flexibility, a rigid coupling shall be used. Fittings for pipe 2 inches and smaller shall be the mechanical compression type.
 - 1. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with *ANSI B31.1* and *B31.9*.
 - 2. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
 - 3. Flange Adapter: Flat face, for direct connection to *ANSI* Class 125 or 150 flanged components.
- F. Mechanical Couplings for Steel Pipe: Fittings shall be ductile iron (*ASTM A536*) forged steel (*ASTM A234*); or fabricated from carbon steel pipe (*ASTM A53*); with pre-grooved ends for use with mechanical couplings of the same manufacturer.
- G. Mechanical Couplings for Hard Copper Tube: Coupling housings shall be ductile iron (*ASTM A536*), coated with copper colored alkyd enamel and cast with angle-pattern bolt pads for system rigidity. Bolts and nuts shall be carbon steel track-type (*ASTM A183*), minimum tensile 110,000 psi. Gaskets shall be Grade "E" EPDM FlushSeal® type, for water services from -30 F to 230 F.
- H. ACR Copper Press Joint Fittings: Fittings 2" and smaller size shall be wrought-copper or cast copper alloy with HNBR O-ring seal and inboard bead design in each end. Fittings shall be compatible with seamless K or L copper tube conforming to *ASTM B280*, *ASTM-B88* and have a maximum operating pressure of 700 psi, burst pressure of 2100 psi, vacuum rating of 200 microns, O-ring temperature range of -40 F to 284 F and UL Listed continuous operating temperature of -40 F to 250 F.
- I. Solvent Cement for PVC Joints: *D2564-88*.
- J. Pipe Sleeves:
 - 1. Iron Pipe Sleeves: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
 - 2. Sheet Metal Pipe Sleeves: Fabricate from galvanized sheet metal closed with lock-seam joints. For following pipe sizes provide gauge indicated: 3" pipe and smaller, 20-gauge;

- 4" to 6" pipe, 16-gauge; over 6" pipe, 14-gauge.
3. Pipe Sleeve Caulking: *3M Fire Barrier Caulk, STI or Grabber.*

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
 1. Comply with *ASME B31.1* Code for Pressure Piping.
 2. Comply with *ASME B31.9* Code for Building Services Piping.
- B. Locate piping runs as indicated on the drawings. Route vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown, or described by diagrams, details, and notations or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Where possible, locate insulated piping for 1" clearance outside insulation. Changes in direction shall be made with fittings.
- C. Piping System Joints: Provide joints of the type indicated in each piping system.
- D. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- E. Mechanical Coupling Joints: Square cut pipe ends and deburr. Roll-groove pipe ends to manufacturer's specifications. Lubricate gaskets completely on interior and exterior using a non-petroleum-based lubricant. Slide gasket over pipe ends between grooves. Engage coupling housing into grooves and tighten until housing bolt pads are in full contact on each side of joint. For pipes 2" and smaller, no groove is required. Mark pipe ends for proper insertion into couplings and fittings. Engage piping into fitting to full depth, indicated by marked pipe ends. Align pipe ends, position compression tool and press trigger until assembly cycle is complete. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

- F. Soldered Joints: Solder copper tube and fitting joints where required, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings with steel wool. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. Use a non-corrosive paste flux and wire solder composed of 95% tin and 5% antimony.
- G. Press Joints: Press tube and fitting joints where required, in accordance with the manufacturer's installation instructions. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings before assembly. The tubing end shall be clean and dry before being inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Installing contractor shall be familiar with the installation of press joint systems and qualified through training provided directly by the fitting manufacturer.
- H. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations and with applicable industry standards.
- I. Insulating (Dielectric) Nipples: Comply with manufacturer's instructions for installing nipples in a manner which will prevent galvanic action and stop corrosion where the joining of ferrous and non-ferrous piping occurs.
- J. Pipe Sleeves: Install pipe sleeves of the types specified wherever piping passes through the walls, floors, or structural members of the work. Provide sleeves of adequate size, accurately centered in pipe runs. Size sleeves so that piping and insulation will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering provide sleeve with sufficient clearance for installation of vapor barrier. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 1/4" above floor finish. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
 - 1. Sleeve Type: At interior partitions and ceilings, install sheet metal sleeves.
 - 2. Sleeve Type: At exterior penetrations both above and below grade, install iron pipe sleeves.
 - 3. Sleeve Type: Except as otherwise specified, install steel pipe sleeves.
 - 4. Caulk pipe sleeves at exterior penetrations and at other locations where indicated.
- K. PVC piping exposed to sunlight shall be coated with water-based latex white paint to prevent UV light degradation.

3.2 CLEANING, FLUSHING, AND INSPECTING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings.

- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.3 PIPING TESTS:

- A. General: Provide temporary equipment for testing, including pump and gages. Test piping systems before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.
 - 1. Required test period is 4 hours.
- B. Unless otherwise specified for specific systems, hydraulically test each pressurized piping system at 150% of operating pressure indicated, but not less than 100 psig test pressure.
- C. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- D. Repair piping systems sections which fail the required piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compound, mastics, or other temporary repair methods. Drain test water from piping systems after repair work and retesting has been completed.

END OF SECTION 230310

SECTION 230320 – MECHANICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory-fabricated piping hangers, and supports of the type specified complete with bolts and washers. Comply with the manufacturer's published product information. Size hangers and supports properly for piping and weight of the medium being transported. Provide insulation shields for all insulated piping.
- B. Hangers for refrigerant lines shall be copper plated band type with adjusting nut; *Anvil* Fig. CT-69, *B-Line* Fig. B3170CT, or equivalent by *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.
- C. Hangers for HVAC drain piping and chilled water piping shall be the standard clevis type *B-Line* Fig. B3100 or equivalent by *Anvil*, *Erico Caddy*, *PHD Manufacturing* or *Hubbard Enterprises/Holdrite*.
- D. Refrigerant Line Set Wall Penetration Seal: Wall outlet seal shall be provided and installed with compression gasket and seal consisting of a Wall Fastening Compression Mounting Method and to must be supplied and fastened with ICC-ES listed non-corrosive Screws with pre-loaded neoprene washers. Wall Outlet must provide an Integrated Over-Molded Flexible Elastomeric Sleeve for sealing, isolating, and supporting refrigerant pipes for Vibration. The Wall Outlet must also provide expansion and contraction wall protection features with gaskets and seals as per energy code requirements. A Stainless-Steel Clamp must be supplied to allow a "Mechanical Connection" as intended per the energy codes allowing off/on removable/reusable maintenance capabilities, and sized to co-act and fit with pipe Insulation protective cover. Wall Outlet installed must ensure that the insulation protector and the wall seal are both securely and mechanically fastened together without the use of adhesives or adhesives tapes as per energy code requirements. Wall Outlet shall be tested and meet the following testing: ASTM E 331 (Water Penetration), ASTM E 283 (Air Leakage), and ASTM E 2178 (Air Permeance of Building Materials). Submit products By *Airex*, *RectorSeal*, or *Acme*.

PART 3 - EXECUTION

3.1 PIPING SUPPORT:

- A. Minimum spacing of hangers and supports for above-ground horizontal and vertical pipe and tubing shall be as required in the applicable *International Mechanical Code*.
- B. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.
- C. Branch piping located in walls, partitions or pipe chases shall be rigidly supported inside the wall or chase.

3.2 ADJUSTMENT OF HANGERS AND SUPPORTS:

- A. Adjust hangers and supports to bring piping to proper level, elevations, and slopes.

END OF SECTION 230320

SECTION 230330 - MECHANICAL EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordination: Where excavation and backfill for mechanical work passes through or occurs in the same areas as work specified in the Division 02 sections, comply with both the requirements of the Division 02 sections and the requirements of this section, whichever is the more stringent (as determined by the Design Professional in cases of conflicting requirements).

1.3 JOB CONDITIONS:

- A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

- A. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

- A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.
- B. General:
 - 1. Do not excavate for mechanical work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
 - 2. Provide signs, illuminations, and barricades as necessary to prevent accidents at excavations.

3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves, and other work. Excavate for other mechanical work to provide minimum practical but adequate working clearances. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
 - a. Piping of 5" and less pipe/tube size.
 - b. Cast-in-place concrete.
6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2' vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
 - a. Retain excavated material which complies with the requirements for backfill material.
 - b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

- A. Maintain dry excavations for mechanical work by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment, or erosion from or through mechanical work excavations.

3.3 BASE PREPARATION:

- A. Install subbase material to receive mechanical work and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.
- B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves, and similar enlargements in the piping systems.

3.4 BACKFILLING:

- A. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.

- B. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.
- C. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously; do not dislocate the work from installed positions.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
 - 1. Lawn/Landscaped Areas: 90%
 - 2. Roadways: 95%
 - 3. Paved Area, Other than Roadways: 95%
- E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
- F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Design Professional.

3.5 PERFORMANCE AND MAINTENANCE:

- A. Where subsidence is measurable or observable at mechanical work excavations during the guarantee period, remove the surface (pavement, lawn, or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 230330

SECTION 230800 - COMMISSIONING OF Mechanical SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC commissioning description.
2. Commissioning submittals
3. Closeout submittals
4. Commissioning Responsibilities
5. Commissioning Meetings
6. Scheduling
7. Coordination
8. Installation
9. Field Tests and Inspections

B. Related Sections:

1. Section 019100 – Commissioning of Mechanical, Electrical, and Plumbing Systems

1.2 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

B. Building Commissioning Association:

1. BCA - Commissioning Handbook.

C. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Building Systems Commissioning.

D. Testing Adjusting and Balancing Bureau:

1. TABB - Commissioning Manual.

1.3 COMMISSIONING DESCRIPTION

A. HVAC commissioning process includes the following tasks:

1. Testing and startup of HVAC equipment and systems.
2. Equipment and system verification checks.
3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.

4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to be Commissioned: The systems addressed by Division 23 that will be commissioned on this project are as follows:

1. Mechanical System. The following mechanical systems shall be commissioned:
 - a. Thermometers and gauges
 - b. Vibration isolation
 - c. Chemical water treatment systems
 - d. Chiller
 - e. Air terminal units
 - f. Duct Silencers (physical observation of the unit)
 - g. Dampers
 - h. Variable frequency drives & motors
 - i. Air distribution systems
 - j. Exhaust air systems and building pressurization controls
 - k. Test and balance verification
 - l. Refrigeration and equipment controls
 - m. Chilled water system

2. HVAC Control Systems. The following HVAC control systems and equipment shall be commissioned:
 - a. Component FPT and calibration
 - b. Air terminal units (non-lab)
 - c. Sequence controls to include:
 - 1) Air handling units
 - 2) Fans (e.g., exhaust air fans)
 - 3) Differential bypass valve
 - 4) Air terminal units
 - 5) Variable speed pumps
 - 6) Heaters (e.g. cabinet unit heaters)

- 7) Water heaters
- 8) Building pressurization
- 9) Air conditions system (e.g. VRF, WSHP)
- d. Graphic display
- e. Trend logs
- f. Status review screens, checks, and alarming
- g. Network communication

3. Renewable Energy Systems. The following renewable energy systems shall be commissioned:

- a. Heat recovery systems
- b. Controls and thermostats

- C. Perform seasonal function performance tests for the following equipment and systems:
 - 1. Heating equipment during heating season.
 - 2. Cooling equipment during cooling season.

1.4 COMMISSIONING SUBMITTALS

- A. Refer to Section 01 9100 – Commissioning of MEP Systems: Requirements for commissioning submittals and in process submittals.
- B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
- C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when the necessary revisions are discovered during commissioning.

1.6 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installers Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Ensure controls installer performs assigned commissioning responsibilities as specified below.
 - 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.

4. Provide instructions and demonstrations for Owner's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
8. Perform and document completed manufacturer's startup and system operational checkout procedures, providing copy to Commissioning Authority.
9. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
10. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
11. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
12. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
13. Provide factory supervised startup services for equipment and systems when required by the applicable sections of the project manual.
14. Perform verification checks and startup on equipment and systems as specified.
15. Perform operation and maintenance training sessions.
16. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installers Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
3. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer. Provide report detailing successful completion of point-to-point checks.
4. Provide building control system access to include user name, password, and all necessary software such that Commissioning Authority can review, evaluate, and test system for proper design and control function. Control system access shall be provided to the Commissioning Authority (regardless of the level of completeness) no later than the date of startup of the first air handling unit (AHU).
5. Inspect, check, and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.

6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes.
3. Assist in performing operation and maintenance training sessions.
4. Notify Commissioning Authority at least seven days in advance of any testing, adjusting, and balancing activity including seasonal.
5. Facilitate and permit in person witnessing of the testing, adjusting, and balancing work by the Commissioning Authority.
6. Provide copies of the in-progress test and balance data to the Commissioning Authority on site witnessing test and balance activity. The data shall be provided at the end of each business day or as requested by the Commissioning Authority.

1.7 COMMISSIONING MEETINGS

- A. Section 01 9100 – Commissioning of MEP Systems: Requirements for commissioning meetings.
- B. Contractor shall attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.8 SCHEDULING

- A. The Contractor shall schedule all Work to allow adequate time for commissioning activities.
- B. The Contractor shall schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.
- C. The Contractor shall schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.9 COORDINATION

- A. Notify Commissioning Authority minimum of seven days in advance of the following:
 - 1. Scheduled equipment and system startups.
 - 2. Scheduled automatic temperature control system checkout.
 - 3. Any of testing, adjusting, and balancing activity to include seasonal.
- B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.
- B. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.
- C. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.
- D. Prior to start of functional performance test, install replacement filters in equipment.

3.2 FIELD TESTS AND INSPECTIONS

- A. Seasonal Sensitive Functional Performance Tests:
 - 1. Test heating equipment at winter design temperatures.
 - 2. Test cooling equipment at summer design temperatures.
 - 3. Participate in testing delayed beyond Material Completion to test performance at peak seasonal conditions.
- B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.
- C. Occupancy Sensitive Functional Performance Tests:

1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

END OF SECTION 230800

SECTION 231110 - MECHANICAL WATER PIPING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

- A. The extent of mechanical water piping work is indicated by the drawings and by the requirements of this section and includes the following:
 1. Chilled Water Supply (CHWS); Chilled Water Return (CHWR)
 2. HVAC Drain Piping (D)
 3. Makeup Water Piping

1.3 SUBMITTALS:

- A. Submit manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

- A. General: Comply with Section 230310 for product requirements of piping materials. For each service, provide the piping materials indicated including pipe, fittings, hangers, supports, anchors, valves, and accessories. Where more than one type is indicated, selection of one type is Installer's option. Where type is not otherwise indicated, provide materials in accordance with industry standards or governing regulations.

2.2 CHILLED WATER PIPING, HOT WATER PIPING, CONDENSER WATER PIPING, HEAT PUMP WATER PIPING:

- A. Above Ground Pipe: Pipe sizes larger than 2" shall be schedule 40 steel. Pipe sizes 2" and smaller shall be hard drawn Type L seamless copper.
- B. Fittings: Wrought steel welding type, cast iron flanged type, cast iron threaded type, mechanical groove joint couplings, mechanical compression joints, or sweat connections as applicable. Use 1.5 radius elbows unless noted otherwise.
- C. Underground Pipe: Underground piping shall be schedule 40 steel carrier pipe with welded joints, factory-applied polyurethane foam insulation and HDPE exterior casing with matching fittings. Pipe shall be by *PermaPipe*, *Rovanco*, or *Thermacor*.

2.3 HVAC DRAIN PIPING:

- A. All Pipe Sizes: Schedule 40 PVC for ductless wall air handlers, dehumidifiers, and humidifiers. Hard drawn Type L seamless copper tubing for AHUs and FCUs
- B. Fittings: Socket type fittings with solvent cement joints. Use standard radius elbows unless noted otherwise. Hard drawn wrought copper with sweat connections.

2.4 MAKEUP WATER PIPING:

- A. All Pipe Sizes: Harddrawn Type L seamless copper tubing.
- B. Fittings: Hard drawn wrought copper with sweat connections. Use standard radius elbows unless noted otherwise.

2.5 ACCESSORIES:

- A. General: Provide factory-fabricated piping accessories recommended by the manufacturer for use in the service indicated. Provide products of the type and pressure-rating specified for each service or, if not specified, provide proper selection as determined by the piping system Installer to comply with installation requirements. Provide sizes and connections matching pipe, tube, valve, and equipment connections. For piping systems requiring up to 2" of insulation, provide an extended valve handle that offers a vapor seal, adjustable memory stop and valve packing maintenance without disturbing the insulation.
- B. Shutoff Valves: Valves 2" and smaller shall be ball valves. Valves shall have two-piece bronze or brass body, meeting *MSS-SP110*, full or standard port, blowout-proof stem, and adjustable packing nut independent of handle. Valves shall be rated for 150 SWP, 600 CWP. Valves shall be by *Apollo, Hays, Milwaukee, Nibco, Oventrop, Victaulic, or Watts*.
- C. Shutoff Valves: Valves 2-1/2" and larger shall be lug or grooved-end type butterfly valves with ten-position handles. Valves shall have minimum pressure rating of 150 WOG with cast iron, ductile iron or bronze body; bronze alloy, offset electroless nickel-plated ductile iron or elastomer encapsulated ductile iron disc, stainless-steel stem, and replaceable EPDM seat and shall have a 2" extended neck. The valve liner design shall be such that it shall serve as a flange seal and no separate gasket shall be required. Valves shall be installed with grooved joint couplings or between ASA 150 steel slip-on flanges. Valves shall be by *Hays, Milwaukee, Nibco, Oventrop, Victaulic, or Watts*.
- D. Drain Valves: Valves shall be bronze construction ball type with TFE seats, angle body, hose end connection with cap and chain. Valves shall be by *Apollo, Hays, Nibco, Oventrop, Victaulic or Watts*.
- E. Manual Balancing Valves: Valves shall have a low loss/high signal venturi flow measuring element and a ball type balancing valve with grid and memory stop. Valves shall be bronze/brass construction rated at 150 psig with sweat, threaded or flanged connections as applicable. Provide two test plugs with a matching portable readout meter for system

- balancing in GPM. Valves shall be as manufactured by *Bell & Gossett, Griswold, Hays, Oventrop*, or *IMI TA-Victaulic*.
- F. Automatic Balancing Valves: Valves shall automatically control flow rates to cooling and heating coils with $\pm 5\%$ accuracy. Valve control mechanism shall consist of a stainless steel cartridge with a ported cup and coil/helical spring to avoid corrosion. The valves shall be available in four PSID control ranges. The manufacturer shall provide independent laboratory tests verifying accuracy of performance. Valves shall be supplied with temperature/pressure test valves and shall be permanently marked to show direction of flow. Valves shall be by *Bell & Gossett, Griswold, Hays, Oventrop*, or *IMI TA-Victaulic*.
- G. Hose Kits: Water connections to coils may be made using *UL Listed* self-balancing hose kits suitable for 200 psig working pressure. Each hose shall have a flame retardant stainless steel sheath and swivel ends. Each hose shall be 24" long with diameter same size as unit connections. Valves, strainers, and accessories required for each individual installation shall be as shown on the drawings and shall be the products of a single manufacturer. Equipment shall be as provided by *Bell & Gossett, Griswold, Hays, Oventrop*, or *IMI TA-Victaulic*.
- H. Pressure Reducing Valves: Valves shall be bronze body construction with renewable seats and integral check valve and strainer. Pressure reducing valves shall be by *Armstrong, Bell & Gossett, Taco*, or *Watts*.
- I. Pressure Relief Valves: Valves shall be bronze construction engineered in accordance with the requirements of Section IV of the *ASME Boiler and Pressure Vessel Code for Heating Boilers*. Capacities shall be certified by the *National Board of Boiler and Pressure Vessel Inspectors*. Valves shall be by *Armstrong, Bell & Gossett, Taco*, or *Watts*.
- J. Back Flow Preventer: Units shall be the reduced pressure principle type. Units shall consist of two spring-loaded check valves with an automatic pressure differential relief valve located between the two check valves. The units shall include shut off valves located at each end and properly located test cocks. Maximum allowable pressure drop through the assembly is 8 psig. Back Flow Preventer shall be by *Febco, Watts*, or *Wilkins*.
- K. Wye Strainers: Provide self-cleaning type wye strainers where indicated. Strainers shall be the iron body type rated for 175 psig W.O.G. Screen shall be monel mesh or perforated metal as recommended by the manufacturer. Provide connections as required. Blowoff outlets shall be equipped with a shut-off valve. Strainers shall be by *Hays, Mueller, Nibco, Oventrop, Watts, Wheatley*, or *Victaulic*.
- L. Air Separators: Provide external type air separation units consisting of a steel tank with flanged connections. Separators shall have a bottom blow-down connection and top connection for venting air. Units shall be constructed in accordance with *ASME Boiler and Pressure Vessel Code* and stamped 125 psig design pressure. Air separator shall be as manufactured by *Armstrong, Bell & Gossett, Oventrop, Patterson, Peerless, Taco, Wheatley*, or *Wood*.
- M. Expansion Loops: Provide units constructed of materials and with proper end connections to match adjoining pipe. The expansion device shall be capable of minimum 1-1/2" movement. Units shall be suitable for 40 F temperature range and 150 psig working pressure and 200 psig test pressure. Pipe guides shall be furnished, located, and installed in accordance with manufacturer's recommendations. Expansion loops and guides shall be as manufactured by

- Metraflex, Flexicraft, Southeastern Hose, or Twin City Hoses.* For pipe sizes 2-1/2" and larger, a series of flexible mechanical couplings may be used instead of expansion loops.
- N. Expansion Tanks: Provide captive air expansion tanks with removable bladder and tank volume as indicated on the drawings. The shell shall be fabricated steel designed and constructed per *ASME Section VIII*. Tanks shall be suitable for a maximum working pressure of 125 psig and a maximum operating temperature of 240 F. Tanks shall be by *Armstrong, Bell & Gossett, Patterson, Peerless, Taco, Wheatley, or Wood*.
- O. Chilled Water Storage Tanks: The vertical chilled water storage tank shall be *ASME* code steel construction at 125 psig working pressure with matching legs, high inlet and high outlet with groove-end connections. Tank shall be furnished with an automatic air vent, low drain, internal divider plate, and 2" thick thermal insulation. Tank shall be by *Amtrol, Bell & Gossett, Cemline, Hanson, Niles, Taco, or Wheatley*.
- P. Flexible Hoses: Provide flame retardant flexible hoses at all water coil connections. Hoses shall be of reinforced, lined rubber with stainless steel sheath and rated for a minimum working pressure of 200 psig. Provide swivel end connections at the coils. Hoses shall be 24" long minimum and shall be by *Hays, Metraflex, Southeastern Hose, Twin City Hoses, or Victaulic*.
- Q. Flexible Pump Connectors: Provide flexible connectors at pump connections where indicated. Flexible connectors shall be of bronze construction with corrugated inner tubing, braided outer shield, and forged flanged ends suitable for water service at 40 F to 240 F temperature range, 125 psig working pressure, and 200 psig test pressure. Connectors shall be as manufactured by *Metraflex, FlexHose, Patterson, Southeastern Hose, or Wheatley*. Flexible mechanical couplings may be substituted for flexible connectors.
- R. Automatic Air Vents: Provide automatic float type air vents in locations indicated on the drawings. Units shall be suitable for a maximum working pressure of 75 psig and a maximum operating temperature of 240 F. Automatic air vents shall be as manufactured by *Armstrong, Bell & Gossett, Patterson, Oventrop, Peerless, Taco, Wheatley, or Wood*.
- S. Manual Air Vents: Vents shall consist of a 1/4" gauge cock with soft drawn copper discharge tube.
- T. Thermometers: Piping system thermometers shall be the bi-metal type with silicon liquid fill, 5" dial, and adjustable angle. The case shall be stainless steel, hermetically sealed, with stainless steel ring. The window shall be double strength glass. The dial shall be white finished aluminum with black and blue markings in degrees F and degrees C. The pointer shall be balanced aluminum with a black finish. Provide an external recalibrator, 1% accuracy of full scale, stainless steel 1/2" NPT connection and stainless-steel stem. The scale range for each gauge shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Thermometers shall be by *Omega, Miljoco, Trerice, Weiss, or Wika*.
- U. Pressure Gauges: Gauges shall be connected to the piping system with threaded brass pipe and fittings. Gauges shall be the flangeless liquid-filled type and shall have 4-1/2" dials, cast aluminum cases, stainless steel heavy duty rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2% accuracy of scale range, plexiglass dial covers, and 1/4" lower connections. Each gauge shall be provided with brass lever handle cock and a

stainless-steel pulsation dampener. Provide compound gauges for locations which are under negative pressure. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Gauges shall be by *Omega, Miljoco, Trerice, Weiss, or Wika*.

- V. Heat Trace Tape for Freeze Protection: Freeze protection tape shall be provided for all above ground water piping outside the building and selected to match pipe size, insulation thickness, and 0 F ambient temperature in accordance with the manufacturer's instructions. Tape shall maintain 40 F minimum water temperature and shall be self-regulating type. Tape shall be by *Chromalox, Raychem, or Watts*.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

- A. General: Comply with requirements of Section 230310 for installation of basic piping materials.
- B. Below Ground: Protect steel pipe with corrosion-resistant pipeline coating over a rubber-based primer by *Polyken* or equal. Joints shall be primed and wrapped with *Foster Cold-Applied Pipeline Joint Tape* or equal.
- C. Air Vents: Install manual air vents at high points in the system and as shown on the drawings.
- D. Take-Offs: Branch take-offs from the supply mains shall be made from the top of the main.
- E. Drains: Install drain connections at the bottom of risers as necessary to permit complete system drainage. Piping slopes shall be as indicated on the drawings.
- F. Painting: Surface preparation and painting shall be in accordance with the Painting Section of the specifications. Apply a minimum of two coats of paint. All steel piping not insulated shall be painted.

3.2 INSTALLATION OF ACCESSORIES:

- A. Install premanufactured accessories in accordance with the manufacturer's instructions and recommendations.

3.3 INSPECTION:

- A. Each length of pipe shall be inspected prior to installation. Ends of open pipe shall be temporarily capped to prevent entry of foreign material prior to connections to other piping or equipment.

3.4 TESTING:

A. Comply with requirements of Section 230310.

3.5 FLUSHING:

A. Comply with requirements of Section 231410.

END OF SECTION 231110

SECTION 231210 – MECHANICAL PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE:

- A. Piping and equipment to be insulated include:
 1. Chilled Water Piping
 2. Makeup Water Piping
 3. HVAC Drain Piping
 4. Refrigerant Piping
 5. Storage Tanks

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation: *Certainteed, Knauf, Manville, Owens-Corning, Pittsburgh Corning, Manson, Armacell, Aeroflex USA, or K-Flex USA.*
- B. Flame/Smoke Ratings: Provide composite piping insulation (insulation, jackets, covering, sealers, mastics, and adhesives) with flame-spread rating not exceeding 25 and smoke developed rating not exceeding 50, as tested by *ASTM E 84 (NFPA 255)* method and *UL 723*.

1.4 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items.

PART 2 - PRODUCTS

2.1 PIPE INSULATION:

- A. Fiberglass Insulation: Insulation shall be preformed, two-piece, heavy density fiberglass with self-sealing ASJ facing conforming to *ASTM C 547*. Insulation on valves, elbows and fittings shall be pre-formed fiberglass with PVC covers and same material thickness as adjacent pipe. Insulation thickness shall be as follows:
 1. Makeup Water Piping: 1” thick for all sizes.
- B. Cellular Glass Insulation: Cellular glass insulation shall comply with *ASTM C 552*, Type II. Jacketing for indoor applications shall be all purpose type of *Kraft* paper/aluminum foil/vinyl

coating construction. Jacketing for outdoor applications shall be 0.016" aluminum. Insulation on valves, elbows and fittings shall be pre-formed cellular glass with PVC covers and same material thickness as adjacent pipe. Insulation thickness shall be as follows:

1. Chilled Water Piping: 1-1/2" thick for pipe sizes up through 4" diameter. 2" thick for pipe sizes 5" through 12" diameter.
- C. Closed Cell Elastomeric Insulation: Closed cell elastomeric glass insulation shall comply with *ASTM C 534*, Type I, Tube Grade 1. Jacketing for outdoor applications shall be 0.016" aluminum. Insulation on valves, elbows and fittings shall be pre-formed closed cell elastomeric with same material thickness as adjacent pipe. Insulation thickness shall be as follows:
1. HVAC Drain Piping: 1" thick for all sizes.
 2. Refrigerant Piping: Per equipment manufacturer's recommendations.
- D. Aluminum Jacket: Corrugated, embossed or smooth sheet, 0.016" nominal thickness, *ASTM B 209*, temper H14, type 3003, 5005 or 5010.
- E. Refrigerant Pipe Insulation Cover: Provide flexible PVC plastic UV/weather protective cover for all refrigerant piping above the roof. The pipe insulation cover shall have an outdoor industrial grade combined method with molecular bonding and integral pre-fastening system that allows removable/reusable use for maintenance and full-enclosure including cut-to-length capabilities without the use of adhesives as an attachment. All pipe insulation material (whether it is exterior surface coated or non-coated) must be completely covered and protected. Provide matching elbow covers. Insulation protector shall be tested and meet *ASTM E 96 (Vapor Transmission of Materials)*, *ASTM G 153 (Carbon Arc Light Exposure – Accelerated Weathering)*, *ASTM D 412 (Tensile Strength after UV Exposure and Water Immersion)* *ASTM 570 (Water Absorption of Plastics)* *ASTM E 84 (Surface Burning Characteristics of Building Materials)*, and *ASTM G 21 (Fungal Growth)*. Pipe insulation cover shall meet Class II vapor retarder per *ASTM E 96 (vapor/moisture permeability test)* "1 perm or less". Color shall be white. Pipe cover shall be by *Airex Manufacturing* or equal approved by the Engineer.

2.2 EQUIPMENT INSULATION:

- A. Insulation for all equipment shall be closed cell elastomeric insulation complying with *ASTM C 534*, Type II, Sheet Grade 1. Insulation thickness shall be 2". Jacketing for outdoor applications shall be 0.016" aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION:

- A. General: Install insulation products in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that the insulation serves its intended purpose. Do not use cut pieces or scraps abutting each other.
- B. Insulation shall be applied on clean dry surfaces. All insulation shall be continuous through wall and ceiling openings and sleeves. Insulation on all cold surfaces, where vapor barrier

jackets are used, will be applied with continuous unbroken vapor seal. Seal off ends of insulation on cold piping systems with white vapor barrier coating at valves, flanges, supports and exposed ends. Supports that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.

- C. Pipe covering protection shields shall be provided around exterior of pipe insulation at pipe hangers which fit around pipe insulation. Shields shall be 12” long by 180 degrees and shall be 18-gauge galvanized steel sheet. High density isolation inserts shall be provided at pipe saddles.
- D. Unions shall not be insulated except for unions in chilled water lines which shall be insulated.
- E. Cover valves, flanges, fittings, and similar items in each piping system.
- F. Extreme care shall be taken to insure a neat, uniform exterior surface on insulation applied to exposed pipes. Insulation in finished areas shall be painted in accordance with the paint specifications.
- G. Heat tracing of piping shall be as specified in Section 231110. Insulation shall be oversized one pipe size.
- H. Aluminum jackets shall be provided on exterior insulated pipes where noted on the plans.

3.2 INSTALLATION OF EQUIPMENT INSULATION:

- A. General: Apply equipment insulation suitable for temperature and service in rigid board to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Fill joints with insulating cement conforming to *ASTM C 195*. Bevel insulation around name plates, *ASME* Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, without damage. Protect exposed insulation corners with corner angles under wires and bands.

3.3 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: The Installer of the insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION 231210

SECTION 231410 - WATER TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide water treatment systems for the following piping systems:
 - 1. Chilled Water System
- B. The work shall include the furnishing of all labor, material, equipment, and services required for the proper installation of the water treatment systems.

1.3 QUALITY ASSURANCE:

- A. The water treatment systems as herein specified shall be furnished and installed in their entirety by a single water treatment company. The water treatment company shall be a recognized specialist in the field of water treatment for at least 10 years and have regional water analysis laboratories and technical representatives located within a 75-mile radius of the job site.
- B. *Chem-Aqua* is the Basis of Design manufacturer. Equivalent name brand equipment manufactured by *Anderson*, *Culligan* and *Mogul* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

1.4 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.
- B. Provide 1/2" scale shop drawings showing the layout of water treatment equipment and piping in the mechanical room. Also provide a piping schematic for the complete system.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. The water treatment system for the chilled water system shall consist of a by-pass type pot feeder.
- B. The water treatment system for the condenser water system shall consist of a packaged

chemical feed and conductivity control system capable of controlling injection of biocide and scale inhibitor and controlling conductivity by controlled bleed of condenser water.

2.2 POT FEEDER:

- A. Provide a pot feeder with 3-1/2" fill opening and two pipe taps. The feeder shall have a minimum capacity and pressure rating designed to meet the requirements of the system.

2.3 CHEMICAL FEEDING AND CONTROL EQUIPMENT:

- A. Provide automatic systems for controlling conductivity and chemical treatment in cooling water systems. Provide all required external wiring and piping. The system shall have the following features and capabilities:
 - 1. Conductivity Monitor: Will provide linear, temperature compensated measurements directly in micromhos over full scale. There shall be two ranges of measurement provided, 50-1,000 micromhos and 500-10,000 micromhos, which shall be field selectable. Conductivity measurement will be displayed on a 2" indicating meter with 0-10 scale. Power switch, set point adjustment, test button, calibration screw, indicating lights and indicating meter shall all be front panel mounted for easy access.
- B. The controller shall be insensitive to phase angle shifts and shall be capable of operating with input line voltage of 95 to 130 volts AC, without affecting accuracy.
- C. Inhibitor Feed: Inhibitor chemical will be fed proportional to makeup water. A water meter with electric contactor shall pulse a solid state reset counter with an adjustable range of 0-99 counts. Completion of the counter cycle will initiate solid state reset timer for activating the inhibitor pumps with adjustable range of 0-10 minutes.
- D. Biocide Feed: Biocide chemical feed will be controlled by a 14-day, 24 hour timer which will actuate a chemical pump whenever required up to a 14 day repeating cycle.
- E. The conductivity monitor, chemical pumps, and sample stream piping assembly shall be mounted on a wall frame structure. This structure shall be fabricated from 14 gauge, cold rolled steel, primed, and painted with polyurethane enamel paint for corrosion protection. All components of the system on the wall frame structure shall be pre-plumbed and pre-wired to form an operational and ready to install system. The system shall have sample stream piping assemblies consisting of:
 - 1. Two (2) 3/4" inlet/outlet shut-off valves rated for 125 psig service.
 - 2. One (1) flow switch rated for 125 psig service.
 - 3. Two (2) 3/4" PVC chemical injection tees.
 - 4. One (1) conductivity probe of PVC construction with a temperature compensating element mounted in a quick-disconnect fitting.
 - 5. One (1) – Pre-piped bleed-off piping assembly consisting of inlet shut-off valve, wye strainer flush valve, throttling valve and differential brass solenoid valve. Bleed-off piping assembly shall be sized to bleed twice the maximum desired bleed-off rate of the system.
 - 6. Two (2) - Chemical feed pumps, positive displacement type with ball-type check valves, shall be provided for feed of the corrosion inhibitor and biocide. Feed rate shall be adjustable while pump is running and necessary polyethylene discharge tubing included.

7. One (1) - Water meter complete with electric contacting register sized to meter twice the volume of the maximum make-up water rate of the system.

2.4 WATER TREATMENT CHEMICALS:

- A. Furnish one year's supply of the recommended formulas for scale and corrosion protection of the closed loop water systems. Also furnish one year's supply of the recommended formulas for control of scale and corrosion in the condenser water system. Provide a separate formula for prevention of microbiological growth in the condenser water system. Biocide products recommended shall be properly registered with the *EPA* and the registration number shall be clearly shown on all product literature and drum labels. To ensure operator safety, all chemicals shall be provided in liquid form for direct feed from the shipping container to the cooling tower water system. All condenser water treatment chemicals shall be compatible with cooling tower material and finish.

2.5 TEST EQUIPMENT:

- A. Furnish basic water test equipment, including carrying case and spare reagents for maintaining control of program standards in the condenser water system and closed loop systems. Test kits will include the following:
 1. Reagents and apparatus for determination of corrosion inhibitor level.
 2. Reagents and apparatus for determination of pH, P & M alkalinity, and chlorides.
 3. Apparatus for determining microbiological colony population and biocide effectiveness.

PART 3 - EXECUTION

3.1 SYSTEM CLEANOUT:

- A. All mechanical water lines and related equipment shall be thoroughly flushed out with precleaning chemicals designed to remove deposition such as pipe dope, oils, loose rust and mill scale and other extraneous materials. Add recommended dosages of precleaner chemical products and circulate throughout the water systems. Drain, fill and flush water systems until no foreign matter is observed and total alkalinity of the rinse water is equal to that of the make-up water.

3.2 INSTALLATION:

- A. Pot Feeder: Feeder shall be wall mounted in a conveniently accessible location adjacent to the system served. Feeder shall be piped between the suction and discharge piping in the vicinity of the system pumps. Bypass piping shall be 3/4" diameter standard weight steel with cast iron screwed fittings. Provide a shut-off valve in the supply and return lines to the feeder, the funnel fill line, and the drain line. Also provide unions in the supply and return lines.
- B. Chemical Feed and Control System: Install the wall-mounted control panel in the location indicated on the drawings. Other items such as conductivity probe, piping assembly,

chemical feed pump and tank, and chemical injection assembly shall be located and installed in accordance with recommendations from the water treatment company representative. Provide all wiring, piping, valves, strainers, and other items necessary for complete operation. The system shall be interlocked with condenser water pump so that water treatment system operates only when condenser water system operates.

3.3 SERVICE PROGRAM:

- A. The water treatment company shall provide all consulting services for a period of one year from start-up of the cooling system which will include:
 - 1. Installation and system start-up procedure recommendations
 - 2. System cleanout procedure supervision,
 - 3. Initial water analysis and recommendations
 - 4. Training of operating personnel on proper feeding and control techniques.
 - 5. A monthly field service and consultation meeting with the owner's representative present.
 - 6. Any necessary log sheets and record forms
 - 7. Any required laboratory and technical assistance

- B. All services will be provided by a qualified, full-time representative of the water treatment company.

END OF SECTION 231410

SECTION 232110 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Industry Standards:

1. Comply with *SMACNA (Sheet Metal and Air Conditioning Contractor's National Association)* recommendations for fabrication, construction and details and installation procedures, except as otherwise indicated.
2. Comply with *ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers)* recommendations, except as otherwise indicated.
3. Provide composite ductwork insulation (insulation, coverings, sealers, mastics, and adhesives) with flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as tested by *ASTM E84 (NFPA 255)* method.
4. Provide duct connectors which comply with applicable portion of *UL 181* and bear label of *Underwriter's Laboratories*.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties as applicable for all items.

PART 2 - PRODUCTS

2.1 ABOVE GROUND DUCTWORK:

- A. General: Galvanized steel ductwork shall be used for all supply, return, exhaust, and ventilation ducts except as indicated otherwise by the contract documents. Preinsulated flexible duct shall be used to make final concealed connections to diffusers, registers, and grilles. Length of flexible duct shall not exceed 5'.
- B. Galvanized Steel Ductwork: Ducts shall be fabricated from G90 galvanized sheet steel complying with ASTM A653, lock-forming quality. Concealed round ducts from Air Handling Units to Terminal Units shall be the spiral seam type with matching fittings. Concealed round ducts downstream of Terminal Units shall be the spiral seam type or snap-lock type with matching fittings. Exposed round supply ducts shall be the double wall spiral seam type with perforated inner wall, 1" thick internal insulation, matching fittings, and paint grip finish.
- C. Flexible Ducts: Flexible ducts shall be *U.L. Listed as Class 1 Flexible Air Duct Material* and

shall comply with *NFPA Standards 90A and 90B*. Duct shall be a factory fabricated assembly composed of a polymeric liner duct bonded permanently to a coated spring steel wire helix and supporting a fiberglass insulating blanket with a minimum R-value of 6.0. Low permeability outer vapor barrier of fiberglass reinforced film laminate shall complete the assembly. Duct shall be suitable for low and medium pressure systems and shall carry a full 5-year warranty. For all flexible duct connections to diffusers, registers, and grilles, provide rigid elbow brace accessory with one duct diameter centerline radius. Flexible duct shall be by *Atco, Flexmaster, Genflex, or Thermaflex*.

2.2 DUCTWORK ACCESSORIES:

- A. General: Except as otherwise indicated for each ductwork accessory, provide metal type, gauge, weight, construction and reinforcing as required by size limitations, and applicable SMACNA standards, including fittings, supports and appurtenances.
- B. Flexible Connectors: Provide flexible connectors between supply and return duct connections to equipment and as otherwise indicated on the drawings. Flexible connector shall be constructed of neoprene permanently attached to 3" wide metal bands. Connector shall be *UL* listed and shall be by *Durodyne, Ventfabrics, Cain, or Ductmate*.
- C. Flexible Duct Elbow Support: Support shall be a radius forming composite polymer brace designed to form flexible duct into a 90-degree elbow. Support shall be *UL* approved for use in a return air plenum and sized to accommodate 4" to 16" flexible ductwork. Support shall be by *FlexRight, Thermaflex, Titus, Malco, or ThermoFlo*.
- D. Manual Balancing Dampers: Provide single blade dampers for round ducts and rectangular ducts less than 12" as indicated on the drawings. Dampers shall be constructed of galvanized steel. Damper shall be installed complete with locking quadrants. For rectangular ducts 12" and wider, provide opposed-blade type dampers constructed of galvanized steel mounted in a galvanized steel channel frame. Blade spacing shall not exceed 6" and the top and bottom edges of the blades shall be crimped to stiffen the blades. Damper blades shall be interconnected by rods and linkages to provide simultaneous operation of all blades. Damper shall be provided with an extended rod to permit installation of a damper regulator. Dampers shall be by *Air Balance, Arrow, Dowco, Jer-Air, Nailor, National Controlled Air, Ruskin, Phillips-Aire, Safe-Air, or United Enertech*.
- E. Round Take-Offs: Round take-offs shall be made using collars constructed of galvanized steel equipped gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. Takeoffs from VAV system trunk ducts to terminal units shall have a conical entry. Take-offs from low pressure trunk ducts shall have 45-degree entry. Takeoffs shall be by *Celcon, Crown, Flexmaster, Jer-Air, Metalcraft, Sheet Metal Connectors, or Thermaflex*.
- F. Rectangular Take-Offs: Rectangular take-offs shall be made using collars constructed of galvanized steel equipped with gasket flange and manual balancing damper with 2" handle standoff. Do not furnish extractors or air scoops. All takeoffs shall have 45-degree entry. Takeoffs shall be by *Celcon, Crown, Flexmaster, Jer-Air, Metalcraft, Sheet Metal Connectors, or Thermaflex*.
- G. Fire Dampers (Walls and Floors): Provide curtain type, hinged blade, vertical and/or

- horizontal mounting fire dampers, suitable for duct penetration or opening protection as required on the drawings. Style 'A' dampers shall be used at wall register/grille locations. Style 'B' dampers shall be used at duct penetrations. Dampers shall meet the requirements of *NFPA 90A* and *UL-555*. Frame shall be minimum 20-gauge galvanized steel with 165 F fusible link. Blades shall be minimum 24-gauge galvanized steel. Dampers shall be by *Air Balance, Greenheck, Nailor, National Controlled Air, Phillips-Aire, Prefco, Ruskin, Safe-Air, or United Enertech*.
- H. Ceiling Radiation Dampers: Provide butterfly type, hinged blade, radiation fire dampers suitable for ceiling opening protection as required on the drawings. Dampers shall meet the requirements of *NFPA 90A* and *UL-555C*. Frame shall be minimum 20-gauge galvanized steel with 165 F fusible link. Blades shall be minimum 22-gauge galvanized steel with *UL Classified* insulation as required by the damper diameter for round dampers and area for rectangular dampers. Lay-in diffusers installations shall also be equipped with *UL Classified* insulating blanket. Provide with extended frame for flexible duct connection. Dampers shall be by *Air Balance, Greenheck, Nailor, National Controlled Air, Phillips-Aire, Prefco, Ruskin, Safe-Air, or United Enertech*.
- I. Smoke Dampers: Provide *UL Classified Low Leakage* smoke dampers suitable for duct penetration or opening protection as required on the drawings. Dampers shall meet the requirement of *NFPA 90A* and *UL-555S*. Frame shall be minimum 16-gauge galvanized steel. Blades shall be minimum 14-gauge galvanized steel airfoil design with silicon rubber edge seals, Leakage Class 1. The assembly shall include a 120VAC 2-position actuator, power-to-open, spring-to-close. Interlock with the building fire alarm system to close on an alarm condition. Smoke detectors will be furnished and installed by Division [26] [27]. Dampers shall be by *Air Balance, Greenheck, Nailor, National Controlled Air, Phillips-Aire, Prefco, Ruskin, Safe-Air, or United Enertech*.
- J. Combination Fire/Smoke Dampers: Provide *UL Classified Low Leakage* fire/smoke dampers suitable for duct penetration or opening protection as required on the drawings. Dampers shall meet the requirement of *NFPA 90A, UL-555* and *UL-555S*. Frame shall be minimum 16-gauge galvanized steel. Blades shall be minimum 14-gauge galvanized steel airfoil design with silicon rubber edge seals, Leakage Class 1. The assembly shall include a 120VAC 2-position actuator, power-to-open, spring-to-close. Interlock with the building fire alarm system to close on an alarm condition. Smoke detectors will be furnished and installed by Division [26] [27]. Damper shall also have a controlled closure device actuated at 165 F. Dampers shall be by *Air Balance, Greenheck, Nailor, National Controlled Air, Phillips-Aire, Prefco, Ruskin, Safe-Air, or United Enertech*.
- K. Duct Access Doors: Duct access doors shall be provided at all fire dampers, smoke dampers, combination fire/smoke dampers, and at control items mounted within ducts. Access doors shall be the double-wall insulated type constructed of galvanized steel not less than 24-gauge for the door and 22-gauge for the frame. Insulation shall be 1" thick and shall be rigid and self-sealing. Doors shall have cam locks on at least two sides. Frame shall have knock over edges for attachment to duct by preening and a vinyl gasket shall be provided between duct and frame. Doors shall match the pressure rating of the ductwork system and be as large as possible and as close as possible to the item served. Door shall be by *Air Balance, Greenheck, Nailor, National Controlled Air, Phillips-Aire, Prefco, Ruskin, Safe-Air, or United Enertech*.

2.3 DUCTWORK INSULATION:

- A. General: Refer to the mechanical plans for duct insulation types and locations. Insulation shall be by *Cerainteed, Knauf, Manville, or Owens Corning*.
- B. Duct Wrap: Type "A" Duct wrap shall be 2" thick, 0.75 pcf density, blanket type fiberglass insulation with vapor barrier and minimum R-Value of 6.7.
- C. Duct Liner: Type "A" Duct liner shall be 1-1/2" thick, 1.5 pcf density, flexible black fiberglass with minimum R-Value of 6.0.
- D. Duct Board: Exterior board type insulation shall be 2" thick, 3 pcf density with minimum R-Value of 8.0. Insulating board shall be faced with foil reinforced *Kraft* (FRK) vapor barrier.
- E. Fire Rated Duct Wrap: All kitchen hood exhaust ductwork shall be insulated with flexible fire-rated duct wrap suitable for zero clearance to combustibles. Where indicated on the plans, fire rated duct wrap may also be used to create fire-rated shafts for other duct systems.
- F. Ductwork Insulation Accessories: Provide mechanical fasteners as recommended by the insulation manufacturer.
- G. Ductwork Insulation Compounds: Provide cement, adhesives, wire wrap, coatings, sealers, protective finishes, and similar compounds as recommended by the insulation manufacturer for the applications indicated.

2.4 MISCELLANEOUS MATERIALS:

- A. General: Provide miscellaneous materials and products of the types and sizes indicated and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Duct Sealant: Duct Sealant for above ground ductwork shall be a mastic suitable for the pressure classification in accordance with *SMACNA HVAC Duct Construction Standard*". All joints and seams shall be sealed.
- C. Ductwork Support Materials: Provide hot-dipped galvanized steel rods, fasteners, anchors, straps, angles, and trim for support of ductwork. Wires shall not be acceptable. Ductwork installed above a roof shall be supported on prefabricated, non-penetrating supports by *Pipe Pier* or approved equal. Provide matching adjustable elevation kits.

2.5 DUCT FABRICATION:

- A. Shop fabricate ductwork in 4', 8', 10' or 12' lengths, unless otherwise indicated or required to complete runs. Preassemble in the shop to the greatest extent possible to minimize field assembly of systems. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for re-assembly and coordinated installation.
- B. Fabricate ductwork with joints, seams and reinforcements as required in the latest edition of *SMACNA HVAC Duct Construction Standards*, 2" static pressure rating unless otherwise

noted on the drawings.

- C. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Elbows shall be either the curved radius type or the square type with 4" single wall turning vanes. Double wall turning vanes are not allowed. Provide stacked single wall turning vanes for larger ducts. Curved radius elbows shall have a centerline radius equal to 1.5 times the duct width. Curved radius elbows with square throats shall not be acceptable.
- D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Where ducts are specified to lined, make allowances for the thickness of the liner. Duct sizes shown on the drawings are clear, inside dimensions.
- E. Kitchen hood exhaust ductwork, dishwasher exhaust ductwork and fume hood exhaust ductwork joints and seams shall have liquid-tight continuous external weld per *NFPA-96*.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK:

- A. General: Assemble and install ductwork in accordance with the latest edition of *SMACNA HVAC Duct Construction Standards* and with recognized industry practices which will achieve airtight noiseless systems, capable of performing each indicated service. Install each run with a minimum of joints. Align ductwork accurately at connections, and with internal and external surface smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of the type which will hold ducts true-to-shape and prevent buckling. Hanger locations shall be coordinated with the building structure and finish conditions.
- B. Complete fabrication of work at the project as necessary to match shop fabricated work and accommodate installation requirements.
- C. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by plans, diagrams, details, and notations or, if not otherwise indicated, run ductwork in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Coordinate the layout with piping, lighting layouts and similar finished work and plumbing risers. Duct layouts shown are diagrammatic and actual location of duct shall be field verified and coordinated by the duct fabricator prior to beginning fabrication of duct systems.
- D. Duct collars shall be provided where ducts pass through walls and partitions which extend full height to the underside of the roof structure. Collars shall be fabricated from 22-gauge galvanized steel sheet. Duct collars shall be provided on both sides of walls and partitions, except collar shall be omitted on that side of the wall where registers and grilles are installed. Flanges shall be installed tight against the wall. The space between the duct and the wall shall be packed with mineral wool.
- E. Coordinate duct installations with installation of accessories, dampers, equipment, controls, and other associated work of the ductwork system.

3.2 INSTALLATION OF INSULATION:

- A. Duct Wrap: Wrap shall be wrapped around duct work with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to duct with 4" strips of fire-resistant adhesive at 8" on centers. On circumferential joints, the 2" flange on the facing shall be taped with minimum of 3" wide foil reinforced *Kraft* tape. On longitudinal joints the overlap shall be taped with a minimum 3" wide foil reinforced *Kraft* tape. On ends of insulation use 3" wide foil reinforced *Kraft* tape to fasten insulation ends to duct. For duct widths 24" and greater, provide additional mechanical fasteners on 18" centers on the bottom of the duct to prevent sagging. Insulate that part of the supply diffusers above the ceiling so that there is no uncovered metal surface subject to condensation. Provide taped-on 12"x12" squares of insulation over damper regulators located above ceilings. All duct wrap shall also be wrapped with wire. All duct insulation installed on duct exterior shall have joints and seams taped and covered with mastic, including connections to equipment.
- B. Duct Liner: Liner shall be applied to the flat sheet with 100% coverage of fire-resistant adhesive. The duct liner shall be cut to assure snug corner closing joints. The black surface of the liner shall face the air stream. On horizontal runs, tops of ducts over 12" in width and sides over 16" in height shall be additionally secured with welded pins and speed clips or grip nails spaced on a maximum of 16" pin centers. On vertical runs, welded pins and speed clips or grip nails shall be spaced on maximum 16" pin centers on all widths over 12". Pins shall start within 2" of the leading edge of each section. Pins shall be cut close to the speed clip. Clips shall be drawn flush only and shall not compress the liner. Coat all exposed edges and the leading edge of all cross joints with fire-resistant sealant.
- C. Duct Board: Board shall be applied using mechanical fasteners such as weld pins or stick clips on 12" centers and not less than 3" from each edge or corner of the board. Apply additional pins or clips where required to hold the insulation tightly against the duct surface. Apply round vapor seal *FRK* pressure-sensitive patches to each fastener. Apply 5" wide pressure-sensitive joint sealing tape to match jacket at all insulation edges and butt joints. All duct insulation installed on duct exterior shall have joints and seams taped and covered with mastic, including connections to equipment.

3.3 CLEANING AND PROTECTION:

- A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of the metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris.

END OF SECTION 232110

SECTION 232210 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Titus* is the Basis of Design manufacturer for grilles, registers, and diffusers. Equivalent equipment by *Carnes, Krueger, Metalaire, Nailor, Price, and Tuttle & Bailey* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- B. *Greenheck* is the Basis of Design manufacturer for louvers. Equivalent equipment by *Airolite, Nailor, Pottorff, Ruskin, and United Enertech* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- C. Industry Standards: Comply with *National Fire Protection Association Standard No. 90A*, as applicable to construction and installation of required devices.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.
- B. Provide standard color selection charts for all air distribution devices. All colors shall be selected by the Design Professional during Submittal Review.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS:

- A. Ceiling Diffusers: Square ceiling diffusers shall be the plaque face type with round neck and one-way, two-way, three-way, or four-way throw as indicated. Diffusers shall be of stamped aluminum construction. Provide 2'x2' T-bar lay-in frame for grid ceilings. Provide radial opposed blade damper. Provide manufacturer's molded backpan R-6 insulation.
- B. Ceiling Diffusers: Round ceiling diffusers, in Auditorium only, shall be the adjustable core type, aluminum construction, with removable core and radial opposed blade damper. Each removable core shall have a safety chain secured to the ductwork. Provide flanged frame for surface mounting. Provide manufacturer's molded backpan R-6 insulation where located in ceilings.

- C. Ceiling Diffusers: All other round ceiling diffusers shall be the plaque face type, aluminum construction, with removable core and radial opposed blade damper. Each removable core shall have a safety chain secured to the ductwork. Provide flanged frame for surface mounting. Provide manufacturer's molded backpan R-6 insulation where located in ceilings.
- D. Linear Slot Diffusers: Diffusers shall be of extruded aluminum construction with one or more parallel slots. Each slot shall contain vanes which can be adjusted from the face of the diffuser to deflect the discharge air along a selected axis within a semicircle of 180 degrees. The same vanes shall also function as volume control dampers. Provide equalizing deflectors for each active length. For continuous installations, butted units shall be provided with alignment splines. Screws or fasteners shall not be visible after installation. Diffusers shall have 1-1/8" wide borders.
- E. Wall Registers: Registers shall be double deflection type complete with opposed blade dampers. Registers shall be of extruded aluminum construction with horizontal front blades on 3/4" centers.
- F. Ceiling Return/Exhaust Grilles: Eggcrate grilles shall be all aluminum construction with 1/2" square eggcrate louvers, 1" deep. All 1'x2', 2'x2', and 2'x4' grilles in lay-in ceilings shall be the lay-in type. All other sizes shall have a flanged frame.
- G. Wall Return/Exhaust Grilles: Horizontal fixed-blade grilles shall be of extruded aluminum construction with 45-degree blades on 3/4" centers.
- H. Heavy Duty Return/Exhaust Grilles: Heavy duty grilles shall have minimum 18-gauge steel border and 16-gauge steel blades on 1/2" centers at 38-degree deflection. Provide support bars on 6" centers.

2.2 LOUVERS:

- A. Hurricane Louvers - Horizontal: *Louvers shall be AMCA 550 Listed (High Velocity Rain Resistant with Blades Fully Open) and AMCA 540 Listed (Wind-Borne Debris Regions).* Louvers shall be approximate 50% free area, constructed of minimum 0.08" thick extruded aluminum, minimum 5" deep, with a full jamb section and channel frame. Front blades shall be horizontal J-style on approximate 2" spacing and back blades shall be rain-resistant vertical type on approximate 1" spacing. Provide a removable aluminum 1/2" mesh bird screen on the inside face of the louver. Finish shall be a factory applied primer suitable for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Install devices as detailed on the drawings and in accordance with manufacturer's written instructions and in accordance with recognized industry practices.
- B. Coordinate with other work, including ductwork and ductwork accessories and ceiling system as necessary to interface installation of grilles and diffusers properly with other work.

- C. Ceiling mounted devices to be installed in lay-in tile ceilings shall be compatible with 2'x2' or 2'x4' T-bar grid as applicable. Refer to Architectural Reflected Ceiling Plans for exact locations of grilles, registers, and diffusers. For flush mounted devices in T-bar ceilings, special care shall be taken to install devices in the center of ceiling tiles. Sagging will not be permitted. Provide rear sheet metal angle bracing.

END OF SECTION 232210

SECTION 232310 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Greenheck* is the Basis of Design manufacturer unless noted otherwise. Equivalent name brand equipment manufactured by *Acme, Carnes, Cook, Penn, Stanley, and Twin City* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- B. Industry Standards:
 - 1. Provide fans which bear *Air Movement and Control Association (AMCA)* certified performance rating seals.
 - 2. Provide fan components which have been listed and labeled by *Underwriters' Laboratories*.
 - 3. Comply with applicable portion of *National Electrical Manufacturer's Association* standards for motors.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties on all items.

PART 2 - PRODUCTS

2.1 ROOF CENTRIFUGAL EXHAUST FANS:

- A. Roof centrifugal exhaust fans shall be the size and type shown on the drawings. Fan shall be direct drive or belt drive as scheduled with heavy gauge spun aluminum weatherproof housing. Motor shall be in a compartment out of the air stream. Fan wheel shall be of composite or aluminum, dynamically and statically balanced, non-overloading backward-curved blades mounted on steel shaft. Provide self-aligning, permanently lubricated heavy-duty bearings, motor, integral thermal overload protection and electrical disconnect switch under ventilator cap.
- B. Provide ECM motor for direct drive fan, aluminum bird screen and backdraft damper. Provide speed controller for direct drive fan. Provide matching roof curb suitable for the roof slope. Curb shall extend minimum 8" above roof surface. Fan shall be capable of resisting wind loads specified in 239110.

2.2 ROOF INTAKE/RELIEF AIR HOODS:

- A. Roof intake/relief air hoods shall be constructed of heavy gauge aluminum with hinged housing. Vertical seams shall be continuously welded with lock formed seams on hood ends. Hoods shall be stressed and sloped for drainage. Provide aluminum bird screen. [Provide matching [barometric relief] [motorized] damper with insulated blades.] Provide matching roof curbs suitable for the roof slope. Curbs shall extend minimum 8" above roof surface. Hoods shall be capable of resisting wind load specified in 239110.

PART 3 - EXECUTION

3.1 INSTALLATION OF FANS:

- A. General: Except as otherwise shown or specified, install fans in accordance with manufacturer's written instructions and in accordance with *National Electrical Code (NEC)* and recognized industry practices.
- B. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48" maximum above the floor.

3.2 TESTING:

- A. After installation of fans has been completed, test each unit to demonstrate proper operation at performance requirements specified, including, but not limited to, proper rotation of impeller. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 232310

SECTION 232410 - AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Carrier* is the Basis of Design manufacturer. Equivalent name brand equipment by *Trane* and *Johnson* that meets performance, capacity, space, and other requirements of the design documents shall be accepted.
- B. Industry Standards:
 - 1. Comply with applicable provisions of *NFPA Standard 90A* pertaining to construction and installation of air conditioning systems.
 - 2. Provide electrical components which are *UL* listed and labeled.
 - 3. Air handling unit performance shall be certified in accordance with *AHRI Standard 430*.
 - 4. Fan performance shall be rated per *AHRI 430* and *AMCA 210*.
 - 5. Coil performance shall be rated per *AHRI 410*.
 - 6. Filter efficiency shall be rated per *ASHRAE 52*.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties.

PART 2 - PRODUCTS

2.1 INDOOR MODULAR AIR HANDLING UNITS:

- A. General: Air handling units shall be the modular central station type complete with fan section, coil section(s), and all accessories as specified and indicated on the drawings.
- B. Coils: Cooling coils shall be the chilled water type. The coils shall be an extended surface fin and tube type construction of copper tubes with aluminum fins. Coil casings shall be constructed of galvanized steel panels reinforced with galvanized steel angle framework. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure underwater. All coils shall be completely enclosed in a coil section and have a drain pan. Coils shall be mounted on tracks for ease of removal. Panel disassembly for coil removal is not acceptable.
- C. Electric Heat: Heating coils shall be the electric type with galvanized steel casing. Element construction shall be open-wire type, 80% nickel, 20% chromium resistance coils with insulated bushings supported in a galvanized steel frame. Provide thermal cutouts for

overtemperature protection per *UL* and *NEC* requirements. Maximum heating density shall be 55 watts/in². Furnish an integral control box containing thermal cutouts, primary control, subcircuit fusing, airflow switch and fused control transformer. Provide door-interlocking disconnect switch.

- D. Fans: Fans shall be the airfoil vaneaxial type of steel construction. Fans shall have tapered inlet and outlet shells over fan hub assemblies for uniformly accelerating air through the blade area. A cast aluminum diffuser, consisting of radially projected straightening vanes with airfoil cross sections, shall straighten air as it leaves the blades. The leading edge of the vanes shall be curved to reduce tonal noise generation. Fans shall be equipped with self-aligning, antifriction bearings with L-50 life of 200,000 hours. Bearing grease lines shall extend through the fan shell. Fan performance shall be tested per *AMCA 211*. Fan sound power levels shall not exceed the limits indicated on the plans.
- E. Unit Casings: All casing panels shall be constructed of 2" thick double wall insulated galvanized sheet steel panels reinforced with galvanized steel angle framework. The casings shall have a galvanized finish and shall be provided with removable access panels located for access to all parts of the equipment. The IAQ drain pan shall be one-piece construction extending under the complete coil section. Drain pans shall be sloped, double wall stainless steel with insulation. The casing must be able to withstand up to 6" positive and 4" negative static pressure. Access doors shall be full sized with metal hinges, safety handles and continuous gasketing. Insulation for air unit casings shall be 2" thick with minimum R-8.0. Reinforced glass viewports shall be factory-installed on the access door(s) of the sections indicated on the plans. Provide with the manufacturers standard marine light factory installed and wired in the sections indicated on the plans. Marine lights shall be factory wired to an externally mounted switch box with an UL listed toggle switch. All factory wiring penetrating the access panels shall be provided in rigid type metal conduit.
- F. Filters: Filters shall be mounted in the air handling unit filter section and shall be 4" thick pleated MERV 13 filters. Filters shall be listed by UL as Class 2. Initial resistance at 500 fpm velocity shall not exceed 0.30" W.G. The media support shall be a welded wire grid. The filter housing shall be provided with a dial type magnehelic gauge for measuring airflow resistance through the filter. Filter section construction shall be identical to unit casings.
- G. Dampers: Outside air/return air dampers shall be provided to modulate the volume of outside and return air. Dampers shall be of airfoil design and shall be either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 cfm/sf at 1" wg. For VAV applications, the dampers shall be modulated by the EMCS as needed to provide a constant outside air cfm under all supply air conditions. Damper module construction shall be identical to unit casings. Where mixing boxes or filter/mixing boxes are indicated, damper shall be integral to the box module.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install air handling units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to ensure that units comply with requirements

and serve intended purposes.

- B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of units with other work.

3.2 TESTING:

- A. Upon completion of installation of units and connection to the completed ductwork and piping systems, start up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 232410

SECTION 232420 - TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Titus* is the Basis of Design manufacturer. Equivalent name brand equipment by *Carrier, EnviroTech, Johnson, Krueger, Metalaire, Nailor, Price, Trane, and Tuttle & Bailey* that meets the performance, capacity, space, and other requirements of the design documents shall be accepted.
- B. Industry Standards:
 1. Insulation and adhesive shall meet *NFPA-90A* requirements for flame spread and smoke generation and *UL-181* requirements for anti-erosion, corrosion, and fungus properties.
 2. Hot water coils, when specified, shall be factory tested for leakage at a minimum of 300 psig with the coil submerged in water.
 3. Hot water coil performance data shall be based on tests run in accordance with *ARI Standard 410*.
 4. Electric heating coils, when specified, shall be *UL* or *ETL* listed and designed to comply with *UL Standard 1096*.
 5. Fan powered units and electric heaters, when specified, shall be designed to comply with *UL Standard 883* or *UL Standard 1995* and shall be *UL* or *ETL* listed as a complete assembly.
 6. Sound power levels shall be *ARI* certified in accordance with the requirements of *ARI-880-89*.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties.

PART 2 - PRODUCTS

2.1 FAN-POWERED VAV TERMINAL UNITS:

- A. General: Factory assembled, externally powered, horizontal fan-powered mixing box with a variable air volume primary control damper and induction fan installed in series or parallel as scheduled. Unit shall be complete with a damper assembly, flow sensor, fan, motor, externally mounted volume controller, collars for duct connection, hanger brackets and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, and coil

- type and coil hand, where applicable.
- B. Unit Cabinet: Constructed of 20-gauge galvanized steel with round primary air inlet connection and centered rectangular discharge suitable for flanged duct connection. Provide top and bottom access panels.
 - C. Insulate with 1" thick foil faced natural fiber insulation which complies with *ASTM C739* and *NFPA 90A*. The liner shall comply with *ASTM G21* and *G22* for fungi and bacterial resistance. All exposed edges shall be coated with *NFPA* approved sealant to prevent entrainment in the airstream.
 - D. Damper Assembly: The damper assembly shall be composed of multiple or single 18-gauge minimum damper blades, utilizing steel damper linkages, and mounted on nylon self-lubricating blade bearing. Dampers shall have a closed cell foam damper seal affixed to the blade, providing a maximum of 2 percent leakage of the maximum rated capacity with an inlet pressure of 3" wg. Damper assembly will consist of one or more blades with a 90-degree travel and shall provide uniform air delivery over the entire face of the unit at all flows.
 - E. Fan(s): Fan wheel shall be a direct driven, double inlet type with forward curved blades, constructed of painted steel. Fan housing shall be steel and mounted to the unit discharge. Fan motor shall be ECM type, multi-voltage (120, 208/240, or 277VAC) design, and shall incorporate an integral automatic reset thermal overload protection. The motor blower assembly shall be capable of being removed from the unit without disassembly of the blower from the motor shaft, through the side or bottom of the unit. Motor shall be mounted to the inlet rings with a torsion flex mounting, on rubber bushings. Motor shall have sleeve type bearings with over-sized oil reservoirs to ensure lubrication. Capacitors shall be selected to provide maximum anti-backward rotation protection. Provide a gasketed backdraft damper at the fan discharge for parallel flow units. Provide fans with SCRs (Speed Control Regulators).
 - F. Electrical Requirements: Unit shall have single point power connection with voltage and phase in accordance with the electrical plans. Provide built-in disconnect switch and control voltage transformer.
 - G. Controls:
 - 1. Units shall have pressure-independent [pneumatic] [electronic] [digital] controls capable of maintaining required airflow set points +/- 5% of the unit's capacity at any inlet pressure up to 6" wg. The controllers shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.
 - 2. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.
 - H. Electric Heating Coil:
 - 1. Heater shall be a flat, horizontally mounted unit, mounted onto a galvanized steel plenum formed as an integral part of the fan terminal unit, and shall be factory installed on the unit's discharge.
 - 2. Units with heaters installed shall be identified on the equipment drawings. Heaters shall be:
 - a. Designed for the capacity, electrical characteristics, and steps of control as shown on

- the equipment schedule.
 - b. Open coil construction with 80% nickel, 20% chromium wire supported in free-floating ceramic bushings. Coil frame shall be constructed of corrosion resistant steel.
 - c. Factory wired and include both a manual and automatic reset safety cutout switch. Fusible links shall not be acceptable. Provide an airflow switch and a built-in power disconnect switch interlocked with the access door.
- I. Filters (Disposable): Galvanized filter frame and filters shall be factory furnished and installed on the induction openings. The filters shall be disposable type, 1" MERV 7.

2.2 SINGLE DUCT VAV TERMINAL UNITS:

- A. General: Factory-assembled, externally powered, variable air volume control terminal. Unit shall be complete with a damper assembly, flow sensor, externally mounted volume controller, collars for duct connection, hanger brackets and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil hand, where applicable.
- B. Unit Cabinet: Constructed of 22-gauge galvanized steel with round or rectangular primary air inlet collar and centered rectangular discharge for flanged duct connection.
- C. Insulate with 1" thick foil faced natural fiber insulation which complies with *ASTM C739* and *NFPA 90A*. The liner shall comply with *ASTM G21* and *G22* for fungi and bacterial resistance. All exposed edges shall be coated with *NFPA* approved sealant to prevent entrainment in the airstream.
- D. Damper Assembly: The damper shall be composed of multiple or single 18-gauge minimum damper blades located in an 18-gauge minimum damper frame. Dampers shall have an open cell foam damper seal affixed to the blade, providing a maximum of 2% leakage of the maximum rated capacity with dampers closed with an inlet pressure of 3" wg. Damper assembly will consist of one or more blades with 90 degree travel and shall provide uniform air delivery over the entire face of the unit at all flows.
- E. Controls:
 - 1. Units shall have pressure-independent [pneumatic] [electronic] [digital] controls capable of maintaining required airflow setpoints +5% of the unit's capacity at any inlet pressure up to 6" wg. The controllers shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.
 - 2. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.
- F. Electric Heating Coil:
 - 1. Heater shall be a flat, horizontally mounted unit, mounted onto a galvanized steel plenum formed as an integral part of the fan terminal unit, and shall be factory installed on the unit's discharge.
 - 2. Units with heaters installed shall be identified on the equipment drawings. Heaters shall be:
 - a. Designed for the capacity, electrical characteristics, and steps of control as shown on

- the equipment schedule.
- b. Open coil construction with 80% nickel, 20% chromium wire supported in free-floating ceramic bushings. Coil frame shall be constructed of corrosion resistant steel.
 - c. Factory wired and include both a manual and automatic reset safety cutout switch. Fusible links shall not be acceptable. Provide an airflow switch and a built-in power disconnect switch interlocked with the access door. Provide built-in control voltage transformer.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Except as otherwise shown or specified, install units in accordance with manufacturer's written instructions and in accordance with *National Electrical Code* (NEC) and recognized industry practices.
- B. Air valve actuators furnished and installed by Section 238310.

3.2 TESTING:

- A. After installation of units has been completed, test each unit to demonstrate proper operation at performance requirements specified, including, but not limited to, proper rotation of fan. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 232420

SECTION 232430 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Carrier* is the Basis of design manufacturer. Equivalent name brand equipment by *Greenheck, Price, Titus, Trane, and Johnson* that meets the performance, capacity, space, and other requirements of the design documents shall be accepted.
- B. Industry Standards:
 - 1. Unit capacities shall be certified under *Industry Room Fan-Coil Air Conditioner Certification Program* in accordance with *ARI Standard 440*.
 - 2. Units must be *UL Listed* as a Fan Coil Unit and comply with *UL 883* and *UL 94*.
 - 3. Units shall be sound rated in accordance with *ARI Standard 350*.
 - 4. Unit shall comply with the *National Electric Code*.
- C. Submittals: Submit manufacturer's data, test reports, product warranties, and available choices of cabinet finish.

PART 2 - PRODUCTS

2.1 HORIZONTAL MODULAR CABINET UNITS:

- A. Units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, stainless steel condensate pans and accessories. Cabinet shall consist of formed double wall insulated panels, 18-gauge G90 galvanized steel, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed. Insulation shall be 1" thick fiberglass. Access panels shall have threaded screw fasteners and gaskets. Provide a filter rack with access doors and 2" thick pleated MERV 13 filters. Filters shall be listed by *UL* as Class 2. Initial resistance at 500 fpm velocity shall not exceed 0.30" wg. The media support shall be a welded wire grid.
- B. Coils shall consist of evenly spaced aluminum fins mechanically bonded to copper tubes. Coils shall be designed for a maximum working pressure of 250 psig and entering air temperature range of 35 F to 200 F. Coils shall be factory tested at 500 psig.
- C. Drain Pans shall be double-wall stainless steel with positive slope per *ASHRAE 62*. Insulation shall be 1" thick fiberglass.
- D. Fans shall be belt driven centrifugal fans consisting of housing, wheel, fan shaft, bearings,

- motor drive assembly, and support structure and equipped with formed steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior neoprene vibration isolation. The fan assembly shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- E. Motors shall be resiliently mounted with sleeve type bearings and integral overload protection and shall operate satisfactorily at 90% of rated voltage on all speed settings. Provide quiet noise rating and maximum ambient temperature rating of 120 F.
 - F. Valve Package: For each unit, provide a valve package consisting of the following: flexible hoses, 3-way, 2-position, 24VAC control valves for chilled water and hot water; manual air vent in each circuit; ball valves in supply and return connections; automatic balancing valves with test ports in return lines; union connections for all lines; strainers with drain valves in supply lines; and insertion test ports in both supply lines. Install a manual ball valve in all bypass pipes. Factory piping and valves shall be tested to coil conditions. All valve package items must be easily accessible.
 - G. All control shall be accomplished by the EMCS system specified in Section 238310. The unit manufacturer shall provide a 120/24VAC transformer rated for 50VA and shall factory-install and factory-wire a DDC control module inside each unit in an accessible location. Modules and wiring diagrams shall be furnished by the EMCS manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install fan coil units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including structural, ductwork, piping, and electrical work, as necessary to interface installation of units with other work.
- C. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48" maximum above the floor.
- D. For all units, furnish and install a new set of filters after all construction is 100% complete.

3.2 TESTING:

- A. Provide a written start-up report.
- B. Upon completion of installation of units and connection to the completed ductwork and piping systems, start-up, and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 232430

SECTION 233110 - ELECTRIC HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *QMark* is the Basis of Design manufacturer. Equivalent name brand equipment by *Berko*, *Chromalox*, *Markel*, *Modine*, *Neptronic*, *Reddi*, *Raywall*, and *Warren* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- B. Industry Standards: Each unit shall be *UL* listed.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. Wall Heaters: Wall heaters shall be the [surface] [recess] mounted fan-forced type. Provide accessory mounting kits as applicable. The heating section shall consist of a steel chassis with heating element, fan and motor, fan control, thermostat, and thermal cutout. Heater section shall be completely prewired. The element shall be the fin-tube type enclosed in a steel sheath. The fan motor shall be impedance protected, permanently lubricated type totally enclosed motor. Fan control shall be bi-metallic, snap-action type delay switch. Thermal cutout shall also be bi-metallic, snap-action type. The front cover shall be heavy gauge steel with a baked enamel finish. Heaters shall have built-in thermostat and disconnect switch.
- B. Unit Heaters: Unit heaters shall be the propeller fan, horizontal discharge type with adjustable louvers. Heating elements shall be the fin-tube type with steel sheath. Cabinet shall be heavy gauge steel with baked enamel finish. Provide bracket for wall mounting. Motor and fans shall be direct drive. Motors shall be the permanently lubricated, resiliently mounted, totally enclosed type with a thermal overload protection with automatic reset. Provide integral thermostat and built-in disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install heaters in accordance with the manufacturer's instructions.

- B. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48” maximum above the floor.

END OF SECTION 233110

SECTION 234110 – AIR-COOLED CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *Carrier* is the Basis of Design manufacturer. Equivalent name brand equipment by *Trane* and *Johnson* that meets performance, capacity, space, and other requirements of the design documents shall be accepted.
- B. Industry Standards: The unit shall be designed, fitted, tested, and rated in accordance with *ARI 550/590-98*. The unit shall also meet all the requirements of *ASHRAE 15* and *ASHRAE 90.1*. Unit shall be *UL* Listed.
- C. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.

PART 2 - PRODUCTS

2.1 AIR-COOLED CHILLER:

- A. General: Water chiller shall be a completely factory assembled one piece packaged air cooled type factory charged with HFC refrigerant. All factory wiring and piping shall be contained within the unit. The unit shall come complete with a steel frame with a factory applied enamel finish. Steel louvered panels shall cover condenser coils. Wire mesh shall cover compressor and evaporator area. Provide neoprene isolators between the unit and support structure. The entire unit shall receive an additional spray-on corrosion protection coating.
- B. Compressor and Motor: Units shall have hermetic scroll compressors or semi-hermetic screw compressors complete with capacity control, vibration isolators, oil sump heater, and differential pressure refrigerant oil flow system. Each refrigerant circuit shall include a compressor suction and discharge service valve, liquid line shutoff valve, refrigerant isolation valve, removable core filter drier, liquid line sight glass with moisture indicator, charging port and an electronic expansion valve. Motors shall be thermally protected. Provide a

matching flexible sound attenuation blanket for each screw compressor.

- C. Evaporator: Shell shall be carbon steel plate designed, tested and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig. All tube sheets shall be carbon steel. Tubes shall be individually replaceable and shall be seamless copper with internal fins. Copper tubes shall be mechanically expanded into the tube sheets. Waterside shall be hydrostatically tested at 1.5 times the working pressure but not less than 215 psig. The shell will have a vent, drain and fittings for temperature control sensors. Insulate evaporator shell and suction lines with a 3/4" thick layer of closed-cell foam plastic. Provide built-in heat tape with thermostat to protect the evaporator down to -20 F ambient.
- D. Condenser and Fans: Air-cooled condenser coils shall have phenolic coated aluminum fins mechanically bonded to internally finned seamless copper tubing. The condenser coil shall have an integral subcooling circuit and shall provide oil cooling for the compressor bearing and injection oil. Condensers shall be factory proof and leak tested at 500 psig minimum. Fans shall be low sound vertical discharge propeller type, dynamically balanced, with permanently lubricated ball bearing and internal thermal overload protection. Unit will start and operate down to 25 F ambient.
- E. Control Panel: Provide a factory-mounted microprocessor-based control panel in weathertight enclosure. Automatic shutdown protection with manual reset shall be provided for low evaporator refrigerant temperature and pressure, high condenser refrigerant pressure, loss of condenser water flow, high motor temperature, low oil flow, motor current overload, phase reversal, phase loss, and severe phase imbalance. Automatic shutdown with automatic reset shall be provided for loss of chilled water flow, high compressor discharge temperature, over/under voltage and momentary power loss. The over/under voltage device shall protect the entire chiller, including control circuits. Provide chilled water reset based on return water temperature. Provide a button keypad for operator input and a "clear language" display. Provide a module to accept generic digital input for current limit setpoint and chilled water setpoint via 2-10 VDC or 4-20 mA.
- F. Electrical: Provide a unit-mounted starter inside a weathertight enclosure with 3-phase solid state overload protection. Scroll compressor starters shall be across-the-line type. Screw compressor starters shall be wye-delta type. Provide factory-installed individual system circuit breakers and a factory-installed and wired control voltage transformer to supply all control power. Provide built-in disconnect switch and convenience outlet.
- G. Hydronic Package: Provide dual in-line type chilled water pumps, check valves, strainer/blowdown valve, air vent, pressure/temperature taps, flow switch, triple duty valve, relief valve and associated piping inside the chiller cabinet. Provide built-in electric heat tape with thermostat to protect the piping down to -20 degrees F ambient. Pumps and heat tape shall be pre-wired into the chiller electrical system for single point power for the entire unit.

PART 3 – EXECUTION

3.1 EQUIPMENT AND COMPONENTS:

- A. Equipment and components shall be completely installed in a manner to insure proper operation of the equipment and controls. Chiller shall be installed in accordance with

manufacturer's instructions. Equipment shall be located so that manufacturer's minimum recommended service clearances are provided.

- B. Unit start-up shall be performed, at no additional cost, by a factory-trained service engineer who, at completion, shall issue a signed report certifying proper operation of the unit.

END OF SECTION 234110

SECTION 234320 - AIR TREATMENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 REFERENCED CODES & STANDARDS:

- A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the Authority Having Jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable *IMC* code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.
 1. *ASHRAE Standards 62 and 52.*
 2. *National Electric Code NFPA 70.*
 3. *UL 2998.*

1.3 QUALITY ASSURANCE:

- A. *Global Plasma Solutions* is the Basis of Design manufacturer. Equivalent name brand systems manufactured by *BioClimatic* and *Phenomenal Aire* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- B. A qualified representative from the manufacturer shall be available to inspect the installation of the air treatment system to ensure installation in accordance with manufacturer's recommendations.
- C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
- D. Projects designed using *ASHRAE Standard 62, IAQ Procedure* shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within *ASHRAE Standard 62.1* to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to *ASHRAE 62.1* and the accuracy of the calculations.
- E. Air Treatment Systems shall have been tested by *UL* or *Intertek/ETL* to prove conformance to *UL 867-2007* including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved *UL 867* prior to December 21, 2007 and have not been tested in accordance with the newest *UL 867* standard with the ozone amendment shall not be acceptable. All manufacturers shall submit their independent *UL 867* test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy

with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

- F. The maximum allowable ozone concentration per the *UL 867-2007* chamber test shall be 0.007 ppm. The maximum peak ozone concentration per the *UL 867-2007* peak test as measured 2” away from the electronic air cleaner output shall be no more than 0.0042 ppm. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

1.4 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties. The following information shall be included in the submittal:
1. Schedule of air treatment systems indicating unit designation and number of each type required for each unit/application.
 2. Data sheet for each type of air treatment systems and accessories furnished indicating construction, sizes, and mounting details.
 3. Performance data for each type of air treatment system furnished.
 4. Indoor Air Quality calculations using the formulas within *ASHRAE Standard 62.1* to validate acceptable indoor air quality at the quantity of outside air scheduled.
 5. Product drawings detailing all physical, electrical and control requirements.
 6. Copy of *UL 2998* test.
 7. Operating and Maintenance Data: Submit O&M data and recommended spare parts lists.

1.5 WARRANTY:

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of eighteen months after shipment or twelve months from Owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the Owner or installing contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. General: Air Treatment Systems shall be the needlepoint bipolar ionization type. Provide an air treatment system for every HVAC unit scheduled on the plans unless noted otherwise on the plans.
- B. The Bipolar Ionization system shall be capable of:
1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
 2. Controlling gas phase contaminants generated from human occupants, building structure and furnishings.
 3. Reducing static space charges.
 4. Increasing the interior ion levels, both positive and negative.
 5. Self-cleaning requiring no maintenance or replacement parts (where specified).
 6. Producing the specified minimum ions/cc.

7. When mounted to the air entering side of a cooling coil, keep the cooling coil free from pathogen and mold growth.
- C. Air Treatment Systems shall operate in a manner such that equal amounts of positive and negative ions are produced. Unipolar ion devices shall not be acceptable. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the system. The air treatment system shall not have a maximum velocity profile.
- D. Air Treatment Systems shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0-100% shall not cause damage, deterioration, or dangerous conditions within the systems. Air treatment systems shall be capable of wash down duty.
- E. Dual Electrode Air Treatment Systems Up To 2,400 cfm (Basis of Design is *GPS-CI-2*):
1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, automatic self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
 2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 2,400 cfm of air flow shall be provided. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
 3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
 4. Electrode pair shall provide a minimum of 160M ions/cc/sec as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 160M ions/cc per electrode pair shall not be acceptable.
 5. Each system shall have an automatic self-cleaning feature. Systems without a no-maintenance, automatic self-cleaning feature shall not be acceptable.
 6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
 7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), and replaceable carbon fiber emitters.
 8. Units shall be mounted in the supply fan inlet(s) and oriented in the airstream to prevent ionization cancellation. For blow-thru equipment, mount the unit downstream of the evaporator coil. Secure to the equipment with magnets.

- F. Duct Mounted Air Treatment Systems (Basis of Design *GPS-DM-2*):

1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed with a molded casing, automatic self-cleaning system, self-cleaning test button, power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
2. Each system shall include the required number of electrodes and power generators sized to the HVAC unit capacity. A minimum of one electrode pair per 2,400 cfm of air flow shall be provided. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
3. Electrodes shall be energized when the main unit disconnect is turned on. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
4. Electrode pair shall provide a minimum of 200M ions/cc/sec as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 200M ions/cc per electrode pair shall not be acceptable.
5. Each system shall have an automatic self-cleaning feature. Systems without a no-maintenance, automatic self-cleaning feature shall not be acceptable.
6. Each electrode pair shall be designed with a banana style plug such that it can be field replaced, if necessary.
7. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC or DC), and carbon fiber emitters.
8. Units shall be mounted in the ductwork and oriented in the airstream to prevent ionization cancellation. Provide matching duct mounting accessory suitable for rectangular ducts and round ducts as needed. Duct mounting accessory shall have quick turn adaptor to receive the ionizer, multipoint fastener collar, and foam gasket.

G. Rigid Bar Air Treatment Systems (Basis of Design *GPS-iMOD*):

1. Where so indicated on the plans and/or schedules, air treatment systems shall be supplied and installed. The mechanical contractor shall mount the systems and wire to the HVAC unit control power (24VAC) or EMCS low voltage power per the manufacturer's instructions or line voltage subject to power available. Each system shall be designed as rigid modular ionization bars available in 6" increments. Ionization bars shall be manufactured from non-metallic materials for corrosion prevention. Each system shall have power status LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per HVAC unit is required to interface to the EMCS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output operating are not acceptable. Manufacturers providing multiple ion modules that have alarm status wired in parallel, and not in series, shall not be acceptable.
2. Each system shall include the required length to cover the entire finned cooling coil width. Ionization bar shall only require 1" in the direction of airflow for mounting and shall attach to the cooling coil entering air header using rare earth magnets. Ion bars shall attach to coils

with stainless steel frames using nylon spacers and self-tapping sheet metal screws in lieu of rare earth magnets.

3. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.
 4. Ion Bars shall provide a minimum of 140M ions/cc/sec/inch as measured at 2", both positive and negative ions, in equal quantities. Devices providing less than 140M ions/cc/inch shall not be acceptable.
 5. Each system shall be provided with an inline on/off switch, universal voltage input (24VAC to 240VAC) and replaceable carbon fiber emitters.
 6. If the ionization bars are mounted immediately downstream from a humidifier, angled hat section protective rain covers shall be provided over the ionization bars deflecting any direct condensation towards the floor and off the bars. These rain covers shall be provided by and installed by the installing contractor. The design of the cover shall be confirmed with the ionization manufacturer prior to installation.
- H. Electrical Requirements: Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with *NEC NFPA 70*. The contractor shall coordinate electrical requirements with system manufacturer during submittals. Where necessary, provide matching dedicated power supply transformer.
- I. Control Requirements:
1. Air Treatment Systems shall have internal short circuit protection, overload protection, and automatic fault reset circuit breakers. Systems with manual fuses shall not be allowed.
 2. Integral airflow sensing shall modulate the plasma output as the airflow varies or stops. A mechanical airflow switch shall not be acceptable to activate the Plasma device due to high failure rates and possible pressure reversal.
 3. The installing contractor shall mount and wire the systems within the HVAC units specified or as shown on the plans. The contractor shall follow all manufacturer IOM instructions during installation.
 4. All systems shall have a means to interface with an EMCS system. Dry contacts shall be provided to prove ions being produced. Systems providing indication that power is applied to the system, but not directly sensing the power at the ion output, shall not be acceptable.

PART 3 - EXECUTION

3.1 GENERAL:

- A. The Contractor shall be responsible for maintaining all Air Treatment Systems until the Owner accepts the building.
- B. Dual electrode systems (*CI-2*) shall be used for all ductless wall and cassette air handlers (DAH),. Use multiple systems as needed based on cfm.
- C. Duct mounted systems (*DM-2*) shall be used immediately downstream of all terminal units (TU). Use multiple systems as needed based on cfm.

D. Rigid Bar systems (*iMod*) shall be used for central station AHU.

3.2 INSTALLATION:

A. All equipment shall be assembled and installed in a workman like manner.

B. Any material damaged by handling, water or moisture shall be replaced by the Contractor at no cost to the Owner.

C. All equipment shall be protected from dust and damage daily throughout construction.

3.3 TESTING:

A. Provide the manufacturers recommended electrical tests.

3.4 STARTUP AND TRAINING:

A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 234320

SECTION 236110 – HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

A. Manufacturers:

1. *Carrier* is the Basis of Design manufacturer for Ductless Heat Pumps. Equivalent name brand equipment manufactured by *Mitsubishi, LG, Trane, York, and Johnson* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

B. Industry Standards:

1. Units shall be rated and certified in accordance with *ARI Standard 210/240/270/340/360/380* as applicable.
2. Units will be certified for capacity and efficiency and be listed in the latest *AHRI* directory.
3. Unit construction will comply with latest editions of *ASHRAE* and *NEC*.
4. Units will be constructed in accordance with *UL* standards and will carry *UL* label of approval.
5. Comply with installation requirements of *ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration*.

- C. Extended Warranty: In addition to the standard one-year warranty on all components, compressors shall bear an additional four-year manufacturer's warranty against material and design defects.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.
- B. Provide factory start-up and testing.

PART 2 - PRODUCTS

2.1 DUCTLESS HEAT PUMPS:

- A. General: Outdoor heat pumps and indoor air handlers shall be a matched pair of one manufacturer rated for operation together by the manufacturer's published literature as a year-round HVAC system. Units shall be complete with features and accessories listed below and as noted on the plans.

- B. Ductless Heat Pumps (Inverter-Driven): Cabinets shall be constructed of galvanized steel, bonderized, and coated with powder coat paint. Provide a hermetically sealed heat pump duty rotary compressor mounted on rubber vibration isolators. Compressor motor shall be NEMA rated Class E. Condenser coil shall be constructed of aluminum fins mechanically bonded to copper tubes. Condenser fan shall be direct-drive propeller type with horizontal discharge. Condenser fan motor shall be totally enclosed type with Class E insulation and permanently lubricated. Fan shaft will be corrosion resistant. Fan blades shall be statically and dynamically balanced. Condenser fan opening shall have a PVC metal/mesh coated safety guard. Refrigeration circuit components shall include liquid-line back-seating shutoff valve with sweat connections, vapor-line back-seating shutoff valve with sweat connections, system charge of R-410A, POE compressor oil, crankcase heater, accumulator, reversing valve, and refrigerant filter drier. Condenser coils shall receive a factory-applied corrosion protection coating.
- C. Ductless Air Handlers: Provide horizontal wall mounted type complete with statically and dynamically balanced centrifugal direct drive fan, indoor coil, standard filters, expansion valves and relays, and controls all housed in a factory-fabricated and insulated steel housing with baked enamel finish. Provide single point power connection. Provide a spare washable filter for each unit.
- D. Unit controls and protective devices shall include high pressure stat, loss of charge pressure stat, suction line accumulator and pressure relief device. Motor compressors shall have a thermal and current sensitive overload device. The outdoor unit shall have short cycle protection and safety lock-out compressor protection. Automatic defrost controls shall be provided. Factory charge with HFC refrigerant. Provide condensate overflow switch.
- E. Refrigerant piping shall be hard drawn seamless copper tubing suitable for a working pressure of 600 psig. Fittings shall be wrought copper or brass suitable for use with high temperature solder and designed for 600 psig working pressure. Suction line insulation shall be plenum rated closed cell foam plastic insulation.
- F. HVAC drain piping shall be Schedule 40 PVC pipe with socket type fittings and solvent cement joints.
- G. Provide manufacturer's 24V interface for use with EMCS space sensor.
- H. See section 238310 for more information.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Installer must examine areas and conditions under which heat pumps are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF HEAT PUMPS:

- A. Install heat pumps where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordinate with other work, including structural, ductwork, piping and electrical work, as necessary to interface installation of heat pumps with other work. Control wiring and devices for complete, operable systems shall be provided and installed under the Mechanical specifications. Wiring shall be installed in conduit provided and installed under the Electrical specifications.
- C. Piping: Refrigerant line joints shall be brazed with silver solder. Lines shall be sized, installed, and insulated in accordance with equipment manufacturer's instructions. Suction line insulation joints shall be sealed with an adhesive recommended by the insulation manufacturer. All refrigerant line insulation exposed to weather shall be protected with a weatherproof coating supplied by the insulation manufacturer. Suction and hot gas line sets shall be secured together with plastic ties. Tape or coated wire shall not be allowed. Hot gas lines located within walls shall also be insulated for vibration isolation. Bare copper piping shall not be allowed to come in contact with masonry, mortar, or steel items. Condensate lines shall be installed with traps and vents in each line. Pipe supports shall be on maximum 6-foot centers on horizontal lines. Open ends of lines and connection fittings of equipment shall be properly capped or plugged during construction to protect from damage and entry of dirt or foreign material.
- D. The mounting height of each wall mounted thermostat or temperature sensor shall comply with ADA for maximum side reach. The thermostat or sensor shall be at 48" maximum above the floor.

3.3 TESTING:

- A. Provide factory start-up and provide a written report.
- B. Upon completion of installation of heat pumps and connection to the completed air distribution system, start-up, and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 236110

SECTION 237310 - HUMIDIFIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

- A. Humidifiers shall be of the electric type, consisting of an electric hot element, evaporating chamber, micro-process control system, factory mounted control panel, air handling unit mounted steam dispersion panel, and interconnecting piping.

1.3 QUALITY ASSURANCE:

- A. *DriSteem* is the Basis of Design manufacturer. Equivalent name brand equipment by *Hermidifier*, *Neptronic*, and *Pure* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.

1.4 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties.
- B. Provide factory startup and testing.

PART 2 - PRODUCTS

2.1 WALL MOUNTED ELECTRIC HUMIDIFIERS

- A. Cabinet: The compartmentalized wall mounted enclosure separates the plumbing, controls, and high-voltage sections to simplify access to the different trades required to install, maintain, and commission the humidifier. Provide cold roll steel and stainless base with baked enamel finish and key locked access doors. Plumbing and high-voltage access panels hang on the edge of the humidifier for easy storage.
- B. Evaporation Chamber: Permanent stainless steel evaporation chamber can be removed by accessing only the evaporation chamber – all other components, such as the heating elements and the steam hose remain permanently fixed. Access the evaporation chamber without any tools by removing the water inlet quick connect, disengaging the latches, and sliding the chamber down using the unique rail-guided system. The evaporation chamber hangs freely on the edge of the humidifier eliminating the need to lift the chamber and place it on the floor or worktable. The heating elements remain fixed within the enclosure without needing to disconnect power cables or move the heating elements, which reduces manipulation and the

weight of the evaporation chamber and saves time.

- C. Elements: Made of *Incoloy* 800/825 with a high coefficient of thermal expansion. The elements are self-cleaning due to their expansion and contraction. Modulation is done using SSR (Solid state relays) with zero crossing detection and firing. The SSR shall not generate spikes, noise, or harmonic distortion on the electrical system.
- D. Piping: Tubing is molded silicone eliminating junctions that could leak and allows for the use of any water type (tap, DI or RO). Provide water inlet valve, drain valve, and motorized pump. A manual drain valve permits draining of the evaporation chamber even during a power failure.
- E. Water Level Detection System: The patent-pending water level detection system with redundancy uses three sensors consisting of a high-resolution capacitive sensor and two resistive sensors. The capacitive sensor and dual resistive sensors cross-verify their respective functions, which results in automatic self-zeroing throughout the lifetime of the humidifier. The two types of water level sensors provide redundancy; if one fails, the other sensor takes over and ensures safe and uninterrupted operation while providing a local/remote warning. A fill valve at the top of the sensors' tube flushes and cleans the sensors at every drain cycle to ensure they are free of deposits.
- F. AFEC (Anti-foaming Energy Conservation): The patented AFEC system ensures proper water level control under varying water conditions (Hard, soft, RO or DI) by initiating a drain only when foam is detected eliminating the need for surface skimming.
- G. Thermal Protection: Two-level temperature protection. The first temperature sensor is located inside the evaporation chamber and the second temperature sensor is located on the outside of the evaporation chamber cover. Either sensor stops the humidifier if a high-temperature condition is detected. Internal drain water to ensure drain water tempering to 140 F or less.
- H. Humidifier Control: Microprocessor-based controller with 128x64 pixel LCD, menu-driven configuration, and (8) configuration buttons including auto/off and drain buttons. Provide the following features:
 - 1. User rights management to display only menu functions available to the type of user logged in.
 - 2. Quick Config Menu displays only the most commonly used functions for faster and easier installation.
 - 3. Independent schedules for unit operation and drain cycle.
 - 4. In-field firmware upgradeable via SD card, USB or BACnet.
 - 5. Simple viewing and exporting of trending log and alarm log.
 - 6. BMS integration via BACnet MS/TP or Modbus.
 - 7. Ethernet module for BACnet IP/Modbus IP and web services for remote configuration and diagnostics.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General: Except as otherwise shown or specified, install units in accordance with manufacturer's written instructions and in accordance with *National Electrical Code (NEC)* and recognized industry practices. Humidifiers and dispersion panels shall be installed as instructed in the manufacturer's printed installation instructions.
- B. The mounting height of each wall mounted humidistat or humidity sensor shall comply with ADA for maximum side reach. The humidistat or sensor shall be at 48" maximum above the floor.
- C. Provide factory start-up for humidifiers and furnish a report of such start-up.

3.2 TESTING:

- A. After installation of units has been completed, test each unit to demonstrate proper operation at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

END OF SECTION 237310

SECTION 237410 - DEHUMIDIFIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. *DriSteem* is the Basis of Design manufacturer. Equivalent name brand equipment by *Aprilaire, Frigidaire, Hisense, Innovative Dehumidifier, and Idylis* that meets performance, capacity, space, and other requirements of the design documents shall be acceptable.
- B. Industry Standards:
 - 1. Comply with applicable provisions of *NFPA Standard 90A* pertaining to construction and installation of air conditioning units.
 - 2. Provide units which shall comply with applicable portions of *UL 465*, and with electrical components that bear *UL* labels.
 - 3. Units shall be rated and certified in accordance with *ARI Standard 240, 270 or 380* as applicable.
 - 4. Comply with installation requirements of *ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration*.
 - 5. Provide minimum 4-year warranty.

1.3 SUBMITTALS:

- A. Provide manufacturer's data, test reports, and product warranties for all items as applicable.
- B. Provide factory startup and testing.

PART 2 - PRODUCTS

2.1 FREE-STANDING DEHUMIDIFIERS:

- A. Single package mechanical refrigeration unit completely piped, wired, and factory tested. The unit shall consist at a minimum of a compressor, condenser coil, evaporator coil, fan motor, air filter, and room air humidity control system.
- B. The unit shall be a free-standing model designed for non-ducted or ducted applications as shown on the plans.
- C. The unit shall have the following features: electronic controls, 3 fan speeds, low temperature operation, front pull-out bucket, bucket-full auto shutoff with indicator, continuous drain

operation, digital humidity readout, antibacterial mesh filter with bottom slide-out access and filter check indicator, R-410a refrigerant, caster wheels and side handles, Energy Star rated.

D. Electrical connection shall be 120VAC with 6' power cord and *NEMA* plug.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which units are to be installed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with the work until the unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF UNITS:

A. Install units where shown, in accordance with equipment manufacturer's written instructions and recognized industry practices, to insure that units comply with requirements and serve intended purposes.

3.3 TESTING:

A. Upon completion of installation of units and connection to the completed air distribution system and pool water piping system, start-up and test equipment in accordance with the manufacturer's recommendations. Operate units to demonstrate capability and compliance with requirements. Where possible, field-correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 237410

SECTION 238310 - ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 OVERVIEW:

- A. This document contains the specification and input/output summaries for a Direct Digital Control (DDC) system. The system architecture shall utilize intelligent distributed DDC controllers, located at each site, which communicate over telephone lines using dial-up modems. The Central Site is a PC based computer, with color graphics and associated printer. The system shall provide the Direct Digital Control (DDC), Energy Management, and Building Automation for the mechanical systems as shown on the drawings and as specified herein.
- B. The following controls companies are allowed to bid: *Andover Controls*

1.3 SCOPE OF WORK:

A. System Requirements:

1. All material and equipment used shall be standard components, regularly manufactured and available and not custom designed especially for this project. All systems and components, except site specific software, shall have previously been thoroughly tested and proven in actual use prior to installation on this project.
2. The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.
3. The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

B. Equipment:

1. System Hardware: The Contractor shall provide the following unless identified as existing:
 - a. Local site computer and stand-alone DDC controllers.
 - b. All relays, switches, indicating devices, sensing devices and transducers required to perform the functions listed in this section.
 - c. All monitoring and control wiring and associated conduit.
 - d. All control power wiring and associated conduit.
 - e. All water control valves and actuators.
 - f. All air valve actuators.
 - g. All variable frequency drives.
 - h. All gas detection monitors and accessories.

- i. All modems and accessories.
2. System Software: The Contractor shall provide all software identified in PART 3 of this specification. The database required for implementation of this specification shall be provided by the Contractor, including point descriptor, alarm limits, calibration variables, graphics, reports, and point summaries.

1.4 REFERENCES:

- A. Codes and Regulations: All electrical equipment and material and its installation shall conform to the current requirements of the following authorities:
 1. *Occupational Safety and Health Act (OSHA)*
 2. *National Electric Code (NEC)*
 3. *International Fire Code*
 4. *International Building Code*
 5. *International Mechanical Code*
 6. *International Energy Efficiency Code*
- B. Note: Where two or more codes conflict, the most restrictive shall apply. Nothing in these plans and specifications shall be construed to permit work not conforming to applicable codes.

1.5 GENERAL CONDITIONS:

- A. Changes in the Work: Within the general scope of the contract, the Owner, without invalidating the contract may order changes in the work consisting of additions, deletions, or other revisions, the contract sum and the contract time being adjusted accordingly. All such changes in the work shall be authorized by written Change Order, and shall be executed under the applicable conditions of the Contract Documents.
- B. Correction of Work:
 1. The Contractor shall promptly correct all work the Owner finds defective or failing to conform to the Contract Documents. The Contractor shall bear all cost of correcting such work.
 2. Within the warranty period required by the Contract Documents, if any of the work is found to be defective or not in accordance with the contract documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so. The Owner shall give notice promptly after discovery of the condition. The Contractor shall guarantee a maximum 4-hour response time, 365 days per year, to have a technician on site to address EMCS problems.
- C. Coordination During Construction:
 1. The Contractor shall coordinate any necessary changes in work scheduling with the Owner to minimize the disruption. The Contractor shall protect the installed works by other trades. The Contractor shall coordinate with other trades.
 2. The Contractor shall repair any damage caused by his work to building(s) and equipment at no additional cost to the owner.
- D. Warranty: The Contractor shall warrant that all systems, subsystems, component parts, and

software are fully free from defective design, materials, and workmanship for a period of one year.

1.6 SUBMITTALS, DOCUMENTATION AND ACCEPTANCE:

A. Submittals:

1. Submittals shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Submittals shall also contain complete wiring, routing, schematic diagrams, tag number of devices, software descriptions, calculations, and any other details required to demonstrate that the system will function properly. Drawings shall show proposed layout and installation of all equipment and the relationship to other parts of the work.
2. Submittals shall be approved before any equipment is installed. Submittals must be submitted in time for the Engineer's review so that all installations can be completed per the project's completion schedule. Ten working days shall be allowed to review submittals.
3. All drawings shall be reviewed after the final system checkout and updated or corrected to provide "as-built" drawings to show exact installation. All submittals will be acknowledged in writing by the Engineer before installation is started and again after the final checkout of the system. The system shall not be considered complete until the "as-built" drawings have received their final approval. The Contractor shall deliver 4 sets of 'as-built' drawings. Before final configuration, the Contractor shall provide I/O Summary forms to the Engineer that include:
 - a. Description of all points.
 - b. Listing of binary and analog hardware required to interface them to equipment for each function.
 - c. Listing of all application programs associated with each piece of equipment.
 - d. Failure modes for control functions to be performed in case of failure.
4. The Contractor shall provide an accurate graphic flow diagram for each software program proposed to be used on the project as part of the submittal process. Revisions made as a result of the submittal process, during the installation, start-up or acceptance portion of the project, shall be accurately reflected in the "as-built" graphic software flow diagrams herein required by this specification.

B. Documentation:

1. The Contractor shall be able to simulate the operation of all software application programs to ensure they are free from design errors and that they accurately accomplish the application sequence of operations. The simulation shall show each output value and how it varies in relation to an artificial time clock. The time clock shall run at normal time increments, increased increments (fast motion) or decreased increments (slow motion).
2. Operations and Maintenance Manuals: Operations and maintenance manuals for the system shall include the following categories: User's Manual; Product Information; Graphic Programming. Project specific manuals shall include detailed information describing the specific installation.
3. User's Manual: System reference material shall contain as a minimum, an overview of the system, its organization, the concepts of networking and central site/field hardware relationships as well as the following:
4. Product Information: It shall include detailed information on hardware and design requirements for initial installations and/or additions to existing systems. Installation

mounting and connection details for field hardware, accessories and central site equipment

5. Graphic Programming: Shall contain as a minimum descriptions of the control software programs used in the system. A graphic flow diagram for each software application program provided as part of this project.

C. Acceptance Test and Acceptance:

1. Upon completion of the installation, the Contractor shall start up the system and perform all necessary calibration, testing, and debugging operations. An acceptance test shall be performed by the Contractor in the presence of the Owner's representative.
2. Controls subcontractor shall provide a completed point-to-point checkout report document for the EMCS system to the Commissioning Authority before scheduling functional testing of the system. The report should be emailed to rsmith@abbevillecx.com.
3. When the system performance is deemed satisfactory, the system parts will be accepted for beneficial use and placed under warranty. At this time, a "notice of completion" shall be issued by the Owner and the warranty period shall start.
4. Owner's Instructions: The Contractor shall provide full instructions to designated personnel in the operation, maintenance, and programming of the system. The training shall be specifically oriented to the system and interfacing equipment installed. Provide a minimum training period of 8 hours.

PART 2 - PRODUCTS

2.1 HARDWARE:

- A. This specification defines the requirements for a distributed Direct Digital Control (DDC) system that interfaces with a PC based Central Site and is capable of handling both analog and binary inputs/outputs on a "stand-alone" basis. The objective of this control concept is to provide a control system with a maximum level of flexibility and reliability by distributing control requirements over a network of microprocessor-based control modules. The system shall perform enhanced control operations to minimize energy consumption.

B. System Concept:

1. The entire system, when complete, shall have a central site computer and a local site computer located as instructed by Owner. The central site is a PC which will be linked to one or more Local Area Networks via auto dial/auto answer modems and separate voice grade telephone lines. To enhance reliability of the system, the central site system shall be used only as an interface to the LAN, not as an active control system.
2. The local site shall be equipped with a DDC controller and a number of control modules. This combination of controllers makes up the LAN for that site.
3. The central site and local site shall be able to interrogate any controller in addition to being able to download program changes to individual controllers.
4. Each controller shall be able to initiate all alarm reporting and selective data uploading to the central site and local site. All controllers shall communicate with each other.
5. Controllers shall be microprocessor based and operate in a stand-alone mode. All controllers shall contain all necessary software programs to provide DDC and energy management functions to the equipment being controlled as specified in this section.
6. Local Site: Desktop workstation shall be a PC-based personal computer, IBM

compatible, with all required serial, parallel and network communication ports and all cables. The CPU shall be a minimum Intel Pentium 4 and operate at a minimum of 2 GHz. A minimum of 128 Megabytes of RAM, one CD-RW drive, and an 80 Gigabit hard disk. A two button mouse will also be provided. The PC shall have a minimum of a 17" SVGA monitor. Include the following accessories:

- a. Modems. Furnish auto-dial telephone modems.
- b. Printers. The work station shall have a color inkjet printer and associated cables.
- c. BACnet. The PC work-station shall read and write BACnet objects (Analog input, analog output, analog value, binary input, binary output, binary value, and device) and allow their use in system applications as described below. The workstation will allow the following:
 - 1) Graphical viewing and control of environment.
 - 2) Scheduling and override of building operations.
 - 3) Collection and analysis of historical data.
 - 4) Definition and construction of dynamic color graphic displays.
 - 5) Editing, programming, storage and downloading of controller data-bases.

C. The central site and local site shall display graphically the following system information:

1. Floor plan maps shall show heating and cooling zones throughout the buildings in a range of colors which provide a visual display of temperature relative to their respective setpoints. The colors shall be updated by the operator through the mouse. Locations of space sensors shall also be shown for each zone.
2. Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. It shall also provide a current status of all I/O points being controlled and applicable to each piece of equipment including analog readouts in appropriate engineering units at appropriate locations on the graphic representation.

D. Mouse: The primary operator interface device shall consist of a 3-button mouse.

E. Keyboard: The enhanced keyboard with 101-key layout shall contain a full ASCII complement and shall include a dedicated numeric keypad with separate ENTER key for rapid entry of data.

2.2 FIELD HARDWARE:

A. Field hardware must be of a modular design to ensure reliability and system performance.

B. DDC Controllers:

1. Each DDC controller must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, A to D conversion, and voltage transient and lightening protection devices. All non-volatile memory shall have a battery backup of at least one year.
2. All point data, algorithms and application software within a local network shall be modifiable from the central site. It shall not be necessary to enter parameters at the local controller for control and programs to operate.
3. Each controller shall execute application programs, calculations, and commands via a microcomputer resident in the controller. The database and all application programs for each controller shall be stored in read/writable non-volatile memory within the controller and will be able to upload/download to/from the central site.

4. Each controller shall be connected to a local site network communicating to/from other controller. Each controller shall include self-test diagnostics which allow the controller to automatically relay any malfunctions or alarm conditions that exceed desired parameters as determined by programming input.
 5. Each controller shall contain both software and hardware to perform full DDC/PID control loops.
 6. Controllers shall be capable of proper operation in an ambient environment of 32 F to 120 F and 10% to 90% relative humidity, non-condensing.
- C. DDC Building Controller:
1. The DDC Building Controller (DDC-BC) is a special purpose controller which contains a communication package to allow transfer of data to and from all controllers within the local site network. Each Gateway shall receive alarms and reports from the controllers in the local network, and shall initiate calls to the central site. In the event the central site is powered down, the alarms shall be stored in the controllers until the central site is restored. The DDC-BC software includes self-test diagnostics which run automatically and allow the DDC-BC to automatically report malfunctions to the central site network.
 2. Each DDC-BC shall have a (up to 9600 Baud) "Smart Modem", with RS-232C connection and automatic answer/originate functions. Each DDC-BC shall also be able to connect directly to central site, or portable terminal, via hardwired Direct Connect.
- D. LANgate Controller:
1. The LANgate shall be a microprocessor-based communications device which acts as a gateway between the System Controller Network (CMnet) and the Global Network (Lgnet).
 2. Both the CMnet and the LGnet shall be "peer-to-peer" networks which allow all control modules to communicate with equal authority.
 3. The LANgate shall be responsible for routing global information from the various CMnets which may be installed throughout a building.
 4. The LGnet may configure as RS485, ARCnet, or Ethernet, all of which may be implemented over fiber optic, twisted pair, or coaxial cable.
 5. The LANgate shall provide two RS232 ports which can be connected to Central Site and local site workstations, portable computers, or modems.
- E. Zone Control Module:
1. Zone Control Modules shall be capable of providing the Direct Digital Control of all equipment.
 2. Each ZCM shall be connected to the CMnet and communicate with equal authority on a "peer-to-peer" basis.
 3. Each ZCM shall execute application programs, calculations, and commands via a microcomputer resident in the ZCM. The database and all application programs for each ZCM shall be stored in read/writable non-volatile memory within the ZCM.
 4. Each ZCM shall contain both software and hardware to perform full DDC/PID control loops. ZCM shall be able to provide analog output, in addition to normal binary type output.
 5. Each ZCM shall be able to support various types of zone temperature sensors, such as: temperature sensor only, temperature sensor with built-in local override switch, with setpoint adjustment switch.
 6. Each ZCM for VAV applications shall have a built-in air flow transducer for accurate air flow measurement in order to provide pressure independent VAV operation.
 7. Each ZCM shall have a built-in detection circuit to monitor the presence of the power to

the equipment, and in case of the absence of the power it shall generate an alarm.

8. Each ZCM shall have LED indication for visual status of communication, power, and all outputs.

F. Instrumentation and Control:

1. Input Devices:

a. Temperature Sensors:

- 1) Sensors shall be of the type and have accuracy ratings as indicated and/or required for the application and shall permit accuracy rating of within 1% of the temperature range of their intended use.
- 2) Sensors used for mixed air application shall be the averaging type and have an accuracy of +1°F.
- 3) Sensors shall have a minimum range of -52 F to 152 F and an accuracy of within +1°F in this temperature range.
- 4) Room temperature sensors shall have an accuracy, of +0.25 F in the range of 45 F to 96 F. Room sensors shall have built-in local setpoint adjustment and timed push-button override.
- 5) Chilled water and condenser water sensors shall have an accuracy of +0.2 F in their range of application.
- 6) Hot water temperature sensors shall have an accuracy of +0.75 F over the range of their application.

b. Pressure Instruments:

- 1) Sensors shall have a 4-20 MA output proportional signal with provisions for field checking. Sensors shall withstand up to 150% of rated pressure, without damaging the device. Accuracy shall be within +2% of full scale. Sensors shall be manufactured by Leeds & Northrup, Setra, Robertshaw, Dwyer Instruments, Rosemont, or be approved equal.
- 2) Pressure switches shall have a repetitive accuracy of +2% of range and withstand up to 150% of rated pressure. Sensors shall be diaphragm or bourdon tube design. Switch operation shall be adjustable over the operating pressure range. The switch shall have an application rated Form C, snap-acting, self-wiping contact of platinum alloy, silver alloy, or gold plating.

c. Flow Switches: Flow switches shall have a repetitive accuracy of +1% of their operating range. Switch actuation shall be adjustable over the operating flow range. Switches shall have snap-acting Form C contacts rated for the specific electrical application.

d. Watt-hour Transducers: Watt-hour transducers shall have an accuracy of +0.25% for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers, and shall have dry contact pulse accumulation.

e. Voltage-to-Digital Alarm Relays: Relays shall monitor status of boiler or chiller safeties and overloads and shall be sized and connected so as not to impede the function of the monitored contacts. Switch shall have self-wiping, snap-acting Form C contacts rated for the application.

f. Current Sensing Relays: Relays shall monitor status of motor loads. Switch shall have self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable.

g. Air Flow Measuring Stations: AFMS shall be installed in the AHU outside air ducts. AFMS shall be same size as the duct. Each station shall contain multiple total and static pressure sensors positioned at the center of equal area of the station cross-section and interconnected by their respective averaging manifolds. The casing shall

be galvanized steel with welded seams, flanged duct connections, straightening grid. Provide an electronic pressure transducer to convert the pressure signals to a 0-10 VDC or 4-20 mA output signal representative of CFM. The station must be accurate to within 2% and operate on 24 VAC. AFMS shall be by Air Monitor, Ruskin, or Kele.

h. Refrigerant Monitor and Controller:

- 1) The refrigerant monitor shall be a self-contained, digital technology, infrared type refrigerant monitor system. The sensor shall be of a modular design consisting of a transmitter module and a sensing module. Both modules shall be powered by a 24-volt power supply. The infrared transmitter shall be fully addressable and shall be capable of communicating digitally within a true daisy chain network. Communication shall be through a RS-485 communication port or Modbus. Monitor and controller shall be *Vulcain Alarm, Inc.*
- 2) The transmitter module shall be capable of indicating the exact concentration of the refrigerant and displayed on a LCD display face mounted in the control panel. The display shall indicate two alarm levels and a fault or 3 alarm levels. The transmitter module shall have 3 failsafe DPDT relays programmed to activate at the alarm or failure state. Transmitter module shall also have an audible alarm with a sound level of 65 dBA at 3'.
- 3) The sensing module shall perform the detection of the refrigerant within the area of protection. Refrigerant shall enter the infrared sensing chamber through diffusion principle without pumps, tubing or mechanical means. The refrigerant sensor shall rely on the reference meter and sensing meter. The reference meter shall continuously monitor the intensity of the infrared beam of light to eliminate drift caused by aging of the infrared light. The sensing meter shall monitor the absorption rate of the targeted refrigerant within the infrared spectrum. Transmitter shall have resolution levels of 1 ppm within a minimum range of 0-1000 ppm. Temperature and humidity variations shall have no effect on the unit's accuracy.
- 4) Refrigerant monitor system shall include a strobe light and horn combination unit. Strobe light/horn shall be mounted outside the mechanical equipment room and visible by entering personnel. Strobe light / horn shall be activated by relay number 2 (high level alarm) in the refrigerant monitor panel. Horn rating shall be 72 dBA at 10'. Strobe light intensity shall be 40 W and flash at a frequency of 1 per second.
- 5) Refrigerant monitor shall detect all refrigerants located in the room containing the sensor. First alarm shall be set a 250 PPM and second or high level alarm shall detect at 500 PPM. First level alarm shall notify the EMCS of the alarm. Second level alarm shall activate the room exhaust fans and open the outside air dampers.
- 6) Refrigerant monitor system shall be *UL 1244* labeled and *CSA 22.2* labeled. Unit shall be manufactured within an ISO 9001 production environment.

i. Carbon Monoxide Detection System:

- 1) The carbon monoxide (CO) detection system shall include a control panel, gas detection sensor, and alarm strobe light/horn. The system shall be as manufactured by *Vulcain Alarm, Inc.*
- 2) The control panel shall include a LCD display, output relays and sensor input boards. DPDT relays shall be programmable and programmed at the factory for the alarm set points. The display shall indicate the exact concentration of gas detected. The control panel shall have an integral audible alarm with a rating of 65 dBA at 3 feet.

- 3) The sensor for carbon monoxide shall be powered by the control panel and shall communicate via a daisy chain network. The detection sensor shall be of the electrochemical cell technology. Unit shall compensate for variation in temperature and humidity and maintain accuracy.
 - 4) Detection system shall have 2 alarm levels. The first alarm shall be set a 35 PPM and shall notify the EMCS of the alarm. The second alarm level shall be set at 200 PPM and shall shut down the control signal for all gas-fired equipment. Sensor shall be located 3' above the floor, and sensor shall have a radius of coverage of 50 feet.
 - 5) Gas detection system shall include a strobe light and horn combination unit. Strobe light/horn shall be mounted outside the mechanical equipment room and visible by entering personnel. Strobe light / horn shall be activated by relay number 2 (high level alarm) in the refrigerant monitor panel. Horn rating shall be 72 dBA at 10'. Strobe light intensity shall be 40 W and flash at a frequency of 1 per second.
 - 6) Detection system shall be *UL 1244* labeled and *CSA 22.2* labeled. Unit shall be manufactured within an ISO 9001 production environment.
- j. Carbon Dioxide Monitor and Controller:
- 1) The carbon dioxide (CO₂) monitor shall be a self-contained, digital technology, infrared type monitor system. The sensor shall be of a modular design consisting of a transmitter module and a sensing module. Both modules shall be powered by a 24-volt power supply. The infrared transmitter shall be fully addressable and shall be capable of communicating digitally within a true daisy chain network. Communication shall be through a RS-485 communication port or Modbus. Monitor and controller shall be *Vulcain Alarm, Inc.*
 - 2) The transmitter module shall be capable of indicating the exact concentration of the CO₂ and displayed on a LCD display face mounted in the control panel. The display shall indicate two alarm levels and a fault or 3 alarm levels. The transmitter module shall have (3) failsafe DPDT relays programmed to activate at the alarm or failure state.
 - 3) The sensing module shall perform the detection of CO₂ within the area of protection. CO₂ shall enter the infrared sensing chamber through diffusion principle without pumps, tubing or mechanical means. The sensor shall rely on the reference meter and sensing meter. The reference meter shall continuously monitor the intensity of the infrared beam of light to eliminate drift caused by aging of the infrared light. The sensing meter shall monitor the absorption rate of the targeted gas within the infrared spectrum. Transmitter shall have resolution levels of 1 ppm within a minimum range of 0-2000 ppm. Temperature and humidity variations shall have no effect on the unit's accuracy.
 - 4) Carbon dioxide monitor system shall be *UL 1244* labeled and *CSA 22.2* labeled. Unit shall be manufactured within an *ISO 9001* production environment.
- k. Duct Smoke Detectors: Ionization type air duct smoke detectors shall be furnished as specified elsewhere by Division 27 for installation under Division 23. All Fire Alarm System wiring for air duct detectors shall be furnished and installed under Division 27. All EMCS wiring for air duct detectors shall be furnished and installed under this section.
2. Output Devices:
- a. Control Relays: Control relay contacts shall be rated for 150% of the loading application, with self-wiping, snap-acting Form C contacts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient

- suppression devices.
- b. Solid State Relays (SSR): Input/output isolation shall be greater than 10 billion ohms with a breakdown voltage of 15 V root mean square, or greater, at 60 Hz. The contact operating life shall be 10 million operations or greater. The ambient temperature range of SSRs shall be 20 F – 140 F. Input impedance shall be greater than 500 ohms. Relays shall be rated for the application. Operating and release time shall be 10 milliseconds or less. Transient suppression shall be provided as an integral part of the relays.
 - c. Water Control Valves: Control valves for chilled water coils and hot water coils shall be the 2-way or 3-way modulating type as indicated on the plans with equal percentage plugs. All valves shall be normally open. Valves 2” and smaller shall have a cast brass body, 150 PSIG, 280 F, with threaded or sweat connections as applicable. Valves 2-1/2” and larger shall have a cast iron body, 150 PSIG, 280 F, with flanged connections. AHU coil control valves shall have DDC actuators, and TU coil control valves shall have DDC actuators.
 - d. Variable Frequency Drives:
 - 1) The variable frequency drives (VFD) shall be pulse width modulation (PWM) type, microprocessor-controlled design. Drives shall be *ABB*.
 - 2) The VFD, including all factory installed options, shall have *UL* approval.
 - 3) Enclosure shall be *NEMA 1* ventilated for installation as a wall mounted unit. Drive shall be equipped with an input disconnect switch and electronic ground fault protection. A hand-off-automatic switch and speed potentiometer shall be mounted on the front of the enclosure. Provide built-in isolation bypass contactors.
 - 4) VFD shall utilize diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.95 regardless of speed or load. VFDs employing power factor correction capacitors shall not be acceptable.
 - 5) Insulated gate bipolar transistors shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency, AC output. A DC line reactor shall be provided to minimize harmonic and current distortion of the input power line.
 - 6) The following user-modifiable adjustments shall be provided:
 - (a) Accel time: 2 to 300 seconds.
 - (b) Decel time: 20 to 300 seconds.
 - (c) Minimum Frequency: 0 Hz.
 - (d) Maximum Frequency: 65 Hz.
 - (e) Current limit: to 115%.
 - (f) V/Hz trim: 10%.
 - (g) Restart time delay: 0 to 255 seconds.
 - 7) Speed reference signal shall be user selectable for:
 - (a) 4-20 mA.
 - (b) 0-5 VDC.
 - (c) 0-10 VDC.
 - (d) 0-20 VDC.
 - (e) 0-20 V phase chop.
 - 8) The VFD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 degrees F. VFD shall be suitable for operation in environments up to 95% non-condensing humidity.
 - 9) The VFD shall be capable of displaying the following information on the door mounted operator interface:

- (a) Percent speed.
 - (b) Percent load.
 - (c) Input kW.
 - (d) Output frequency.
 - (e) Fault identification.
 - (f) Output current.
- 10) Provide field-mounted pressure sensor transmitters as indicated on the plans. Unit shall transmit an isolated 4-20 mA dc signal indicative of process variable to the logic controller via standard two wire 24 VDC system. The unit shall be accurate to within 0.25% of full span.
- 11) Local Site Communication Network: The modules shall communicate within their respective network with a token passing technique. This network shall be consistent with the *IEEE RS-485* standard, including a minimum baud rate of 9,600 BPS maintained at a minimum of 10,000'.
- 12) Field Testing and Programming Equipment: A portable laptop computer shall interface via standard push-in connection at an asynchronous serial port located at the control modules. This portable unit shall be capable of full global communications with all control modules connected within the respective network and shall provide functionally identical user interface to the central site, in non-graphic format. Units shall be able to interrogate all points and alter all programming. The unit shall have 80x25 character liquid crystal display panel.

2.3 SOFTWARE:

- A. The Contractor shall provide all software required for efficient operation of all the functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system.
- B. The software shall, as a minimum, include:
 - 1. Complete database entry.
 - 2. Configuration of all application programs to provide the sequence of operation indicated.
 - 3. Graphics of each system.
 - 4. Alarm limits and alarm messages for all critical and non-critical alarms.
 - 5. Configuration of all reports and point summaries indicated
- C. The software shall be provided in these five categories:
 - 1. System executive software
 - 2. Software for user control over system configuration at the CS location
 - 3. Facility monitoring functions
 - 4. Direct digital control
 - 5. Application software

2.4 SYSTEMS SOFTWARE:

- A. The central site and local site shall display graphically the following system information:
 - 1. General area maps shall show locations of controlled buildings in relation to local landmarks.
 - 2. Floor plan maps shall show heating and cooling zones throughout the buildings in a range of colors which provide a visual display of temperature relative to their respective

- setpoints. The colors shall be updated by the operator through the mouse. Locations of space sensors shall also be shown for each zone.
3. Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. It shall also provide a current status of all I/O points being controlled and applicable to each piece of equipment including analog readouts in appropriate engineering units at appropriate locations on the graphic representation.
- B. Each category of software shall consist of interactive software modules. Each module shall have an associated priority level and shall execute as determined by the program controller as defined in the real time operating system.
 - C. The central site and local site shall allow receipt of alarms and messages while in a functional mode other than energy management, i.e., incoming alarms shall be displayed while the operator is in a word processing, spreadsheet, or other operating mode. The system must automatically switch from a non-energy management mode, respond to an alarm, and return to the exact position left in the previous functional mode.
 - D. The building operator shall be able to communicate and direct all control functions through the use of a 2-button "mouse" operator interface to monitor and control all functions and sequences within the system.
 - E. The following information shall be selectable from a "pop-up/pulldown" menu available on various graphics.
 - F. Programming, scheduling and setpoint changes shall be accessible for modification on each menu for the associated equipment. Operator shall be able to automatically download changes from the central site to the appropriate program for the equipment being controlled. Operator shall be able to upload parameters, setpoint information and schedules from the field modules to the central site and local site.
 - G. Input Format: Operators shall be able to control system functions based on their password level. The primary operator interface shall be a 3-button mouse.
 - H. Operator Commands: All operator commands shall be in the graphics database and menu driven. After the operator selects the desired object item or menu, the system shall display either the status of selected object item or the allowable options available. Upon entry of a command to the point or points desired as described above, the system shall, before performing any command, respond with an echo of the request. This echo feedback shall include the command requested and any entered data. System shall include error monitoring software for user's input error.
 - I. Output Format:
 1. The system shall operate on a system format basis, regardless of the manner or hardware configuration in which the data is acquired. A "system" shall consist of a logical grouping of data points, related to a piece of mechanical equipment, an energy distribution system, or an architectural area. For example, in some cases, it may be desired to display, as a single system, a space temperature with its associated AHU, and in other cases to display all space temperatures on a floor or in a building. The DDC shall allow such determinations to be made without regard to the physical hardware locations of a point or group of points. Likewise, the system shall accommodate future

- changes of system grouping and operations without field hardware changes.
2. All displays and logs shall contain a header line indicating date, day-of-week, and time.
 3. All output displays or logs of a point or group of points shall contain, as a minimum, the following information:
 - a. Graphic presentation of the System
 - b. User name of point
 - c. Point descriptor
 - d. Current value/status
 - e. Associated engineering units
 - f. Alarm description
 4. User names, point descriptors, and engineering units shall be operator definable on a per point basis.
- J. Setpoints:
1. The system shall utilize a contiguous band of colors each corresponding to actual zone temperatures relative to the desired heating and cooling setpoints. The ideal temperature shall be shown as a green color band. This color band corresponds to the dead band between the onset of mechanical heating or cooling. Temperatures slightly warmer than ideal shall be shown in yellow, and even warmer temperature band shall be shown in orange.
 2. Temperatures slightly cooler than ideal shall be light blue, and even cooler temperatures shall be shown as dark blue. All alarm colors shall be in red.
 3. The system shall be capable of utilizing the mouse operator interface device to change individual zone temperature bar and by pressing a button, and by moving the mouse cursor to an increased or decreased temperature setpoint within that zone. The system shall also be capable of utilizing the mouse interface device or a conventional keyboard to change a numeric temperature setpoint value instead of utilizing the graphic temperature bar. The floor plan graphic shall then be able to change colors on a zone by zone basis to reflect the actual temperature in each zone relative to the changed desired heating or cooling setpoint.
 4. The system shall be capable of globally changing all setpoints. The global change capability shall be accessed via a 'pop-up/pull down' menu called by depressing a button on the mouse.
- K. Graphic Structure:
1. The intent of the graphics is to ensure the operator is always aware of his position within the system as well as how to logically progress through the graphical hierarchy to select any desired graphic or other source of information. DDC/EMS software shall provide the operator with the capability of returning to any previous graphic by pointing to a graphic tab then pushing a single button on the mouse operator interface.
 2. The DDC/EMS must be programmed to provide a separate color graphic for:
 - a. Each piece of equipment monitored or controlled
 - b. Each building
 - c. Each floor and zone controlled
 - d. Each schedule
 - e. Each trend
 - f. Each report
- L. Passwords: User Access Restriction. Operator sign-on shall require an assignable password. System shall have up to (32) passwords, each of which may be one of six types of system access:

1. Type 1 – Trainee: This level shall allow readout of data only. The system shall display all operation database.
 2. Type 2 - Maintenance 1: This level shall allow a performance of Type 1 functions plus the changing of all schedules.
 3. Type 3 - Maintenance 2: This level shall allow performance of Type 2 functions plus the changing of all setpoints.
 4. Type 4 – Supervisor: This level shall allow performance of Type 3 functions plus the changing of all system part.
 5. Type 5 - System Programmer: This level shall allow performance of Type 4 functions plus the modifying the system configuration.
 6. Type 6 - System Manager: This level shall allow performance of Type 5 functions plus the changing of passwords.
- M. Power Failure/Automatic Restart at the Controller:
1. Power failures shall cause the controller to go into an orderly shutdown with no loss of program memory.
 2. Upon resumption of power, the controller shall automatically restart and printout the time and date of the power failure and restoration at the respective central site system.
 3. The restart program shall automatically restart affected field equipment. The operator shall be able to define an automatic power up time delay for each piece of equipment under control.

2.5 USER CONTROL OVER SYSTEM CONFIGURATION

- A. Database Creation and Modification: All changes shall be done utilizing standard procedures and be capable of being done while the system is on-line and operational. The system shall allow changes to be made at the local site through a portable computer and the Central Site.
- B. The system shall permit the operator to perform as a minimum the following:
1. Add and delete points.
 2. Modify point parameters.
 3. Create and modify control sequences and programs.
 4. Reconfigure application programs.
 5. Add and/or modify graphics.
- C. All data points within the database shall be completely accessible as independent or dependent variables for custom programming, calculation, interlocking, or manipulation.
- D. Graphics Software:
1. The graphics software shall permit the easy construction of infinitely variable shapes and sizes through the use of the mouse pointing device.
 2. A selection of colors and various fill textures, line types and text styles shall all be accessible through the use of the mouse interface. The software shall resemble many of the computer aided design programs currently available and allow graphics to be easily moved, edited, added or deleted.
 3. Graphics software shall be fully implemented and operational to accomplish the following:
 - a. Create a new graphic picture.
 - b. Modify a portion of a graphic picture.
 - c. Delete a graphic picture, or any portion thereof.

- d. Call up a graphic picture.
 - e. Cancel the display of a graphic picture.
 - f. Assign conditions which automatically initiate the display.
 - g. Overlay alphanumerics and graphics.
 - h. Save the graphic picture.
 - i. Display latest process data fully integrated with the graphic display.
4. The central site and local site shall be able to generate standard ASCII file formats to allow use with third-party software to generate and store owner-designed reports.

2.6 FACILITY MANAGEMENT FUNCTIONS:

A. Trend Logging:

1. The system shall be able to trend and display either numerically or graphically any analog, digital or calculated points in the system.
2. The system shall be able to simultaneously graphically display any four (4) trended points within a module function block showing the most recent samples.
3. Each field module shall be capable of storing the most recent samples for every hardware point in the module with sample intervals as small as one (1) second. Operator shall be able to select and display graphically the trends of up to four (4) points simultaneously on a single trend graph.
4. Each module shall be capable of automatically uploading on a daily basis all accumulated trend data to the central site for permanent storage on hard disk.

B. Run Time:

1. The system shall provide run time information for all digital output and input points for all modules on command from the operator. Maximum run time limits shall be operator definable and shall be capable of automatically issuing a printed message when the run time maximum is exceeded. The operator shall be able to reset the run time accumulator.
2. Run time hours and start time date shall be retained in non-volatile module memory.
3. Each module shall be capable of automatically uploading all accumulated data to the central site and local site for permanent storage on hard disk.

C. Alarm Conditions and Maintenance Messages:

1. The central site and local site shall allow receipt of alarms and messages while in a functional mode other than energy management; i.e., incoming alarms shall be displayed while the operator is utilizing another mode such as word processing and allow the operator to automatically return to word processing after the alarm is received.
2. The system shall distinguish between alarms and messages with alarms having a higher priority.
3. The system shall be capable of calling up to three different remote locations to deliver an alarm or message. The operator shall determine if alarms or messages are to be based on temperature limit, status or off-normal reporting.
4. The system shall be capable of printing maintenance messages when run time accumulation maximum limits are exceeded.
5. The text for operator alarm and messages shall be operator definable. The system shall be capable of storing at least 100 messages each of any length. Generic messages used for multiple points throughout the system shall only count as one message.
6. In the event the central site or local site is powered down, the alarms shall be stored in the modules until the site is restored. System should have the optional capability to deliver simultaneous alarms to multiple sites.

7. The site shall be capable of transferring all alarms to hard disk for storage.

D. Reports and Archiving:

1. The field controllers shall be capable of calling the central site and local site during off peak phone rate hours to automatically upload all current and accumulated data. This shall be delivered to the site for printing and/or permanent storage on hard disk. The system shall further be capable of transferring hard disk information onto a floppy disk or magnetic tape for remote site storage.
2. The system shall be capable of reporting and archiving the following information as a minimum:
 - a. Outside air temperature history and degree-day history.
 - b. Electric demand and usage history.
 - c. All trended points.
 - d. All alarms and messages.
 - e. Equipment runtime information.
3. The system shall also provide the following additional reports for which archiving is not applicable:
 - a. All points summary.
 - b. Building operating schedules.
 - c. Printout of any graphic screen.
4. The system shall be capable of providing all points summaries on a hierarchical basis. e.g., only the points associated with a particular graphic shall be selectable and printed. For example, if the operator is viewing an AHU, he may request an all points summary at this level and receive only the points associated with the AHU. If the building is being viewed and an all points summary selected, all building points shall be listed. Similarly, the system shall print building operating schedules pertinent to the graphic level being viewed. e.g., If a zone or tenant zone group is being viewed on the graphic display, then the system shall be capable of printing the building operating schedules for the zone or tenant zone group. If the entire building graphic is being viewed, the system shall be capable of printing schedules at the building level.
5. All system reports shall be capable of being viewed at the operators terminal and printed at the operator's discretion.

E. Custom Reports and Logs:

1. The operator shall be able to create custom report and logging formats using the DOS based text editor program provided as part of the requirement for this project.
2. The operator shall be able to have the system report desired point data from the field, insert the data in the custom report format, store the report on disk as well as have it print out on the system and/or remote printers.
3. Custom report generation shall be initiated either manually, based on a field occurrence or based on time, or any combination.

2.7 DIRECT DIGITAL CONTROL SOFTWARE:

- A. The system shall continuously perform DDC functions at the local controller in a stand-alone mode. The operator shall be able to design and modify the control loops to meet the requirements of the system being operated. The operators shall use system provided displays for tuning of PID loops. These displays shall include the past three input variable values, the setpoint for the loop as well as the sample interval and the results of the proportional, integral and derivative effects on the final output.

- B. Only true analog out capability for continuously variable output control will be permitted. Output capability shall include 4-20 MA.
- C. Each controller shall perform the following functions:
 1. Identify and report alarm conditions
 2. Execute DDC algorithms
 3. Execute all application programs indicated on the I/O Summary Table
 4. Trend and store data
- D. In the event of a controller failure, all points under its control shall be commanded to the failure mode as indicated.
- E. All DDC software shall reside in the respective controller.

2.8 APPLICATIONS SOFTWARE: The following applications software shall be provided for the purpose of optimizing energy consumption while maintaining occupant comfort:

- A. Scheduled Start/Stop (SSS): The system shall be capable of the following scheduling features:
 1. Schedule up to (32) schedules per building, area, zone, groups of zones, individually controlled equipment and groups of individually controlled equipment. Each schedule shall provide beginning and ending dates and times (hrs: minutes). A weekly repeating schedule, i.e. between 8:00 a.m. and 5:00 p.m., Monday through Friday shall constitute one schedule, not five.
 2. Allow dated schedules to be entered up to 3 years in advance.
 3. Schedules shall be self-deleting when effective dates have passed.
 4. Automatically adjust for leap years.
 5. For maximum speed in the communication of schedules, the operator shall have the ability to communicate schedules at the most efficient level with one scheduling command through the mouse interface. This ranges from system-wide to individual zones, groups or pieces of equipment.
 6. The system shall allow the operator to designate any combination of equipment to form a group that can be scheduled with a single operator command through the mouse interface at the central site. Any designated group shall have the capability to be a member of another group.
 7. The operator shall be able to make all schedule additions, modifications and deletions using the mouse and "pop-up/pulldown" menus.
 8. The operator shall have the ability to edit all schedules off line and then download any or all schedule changes to the controllers with a single operator command through the mouse interface.
 9. The operator shall have the ability to upload any or all schedules from a controller in the event the schedule in the controller is different from the database in the CS being used.
 10. The operator shall be able to view a color coded, five-day graphic forecast of schedules for instant overview of facilities schedules. Graphic forecast shall include colored coded indication of all types of schedules, i.e. normal, holiday and override. The graphic forecast shall show inconsistencies between central site schedules and those located within field control modules.

- B. Optimum Start/Stop (OSS)/Optimum Enable/Disable (OED):

1. Provide software to start and stop equipment on a sliding schedule based on the individual zone temperature and the heating/cooling capacity in °F/hr. of the equipment serving that zone. The heating/cooling capacity value shall be operator adjustable.
 2. Temperature compensated peak demand limiting shall remain in effect during morning start up to avoid setting a demand peak.
- C. Source Temperature Optimization (STO):
1. The system shall be capable of automatically optimizing all air handling units, chillers and boilers response to the needs of other downstream pieces of equipment, by increasing or decreasing supply temperature setpoints, i.e. chilled water, discharge air, etc. using owner defined parameters.
 2. Likewise, the DDC/EMS system controlling the chiller and boiler shall continuously adjust the chilled water supply temperature or hot water supply temperature up or down by operator defined temperature amounts to provide the least energy necessary to cool or heat the building to the optimum comfort settings on a zone by zone basis.
- D. Demand Limiting (DL):
1. Application shall be programmable for a minimum of six separate time of day KW demand billing rate periods.
 2. The system shall be capable of measuring electrical usage from multiple meters serving one building and each piece of equipment being controlled on the LAN shall be programmable to respond to the peak demand information from its respective meter.
 3. The demand control function shall utilize a sliding window method with the operator being able to establish the kilowatt threshold for a minimum of three adjustable demand levels. Sliding window interval shall be operator selectable in increments of one minute, up to 60 minutes. Systems that incorporate rotating shed tables will not be acceptable.
 4. The operator shall have the capability to reset the individual equipment temperature setpoints for each demand level. Equipment shall not be shed if these reset setpoints are not satisfied.
 5. The system shall have failed meter protection, such that when a KW pulse is not received from the utility within an operator adjustable time period, an alarm will be generated. The system software will automatically default to a predetermined fail-safe shed level.
 6. The system shall display a graphic trend of the last 60 samples of user defined demand periods. Intervals shall be defined by the Owner in multiples of one minute. The system shall have the ability to archive demand and usage information for use at a later time. System shall permit the operator access to this information on a current day, month-to-date and a year-to-date basis.
- E. Day/Night Setback (DNS):
1. The system shall allow the space temperature to drift down (up) within a preset (adjustable) unoccupied temperature range. The heating (cooling) shall be activated upon reaching either end of the DNS range and shall remain activated until the space temperature returns to the DNS range.
 2. The system shall be capable of closing all outside air and exhaust air dampers during the unoccupied period.
 3. Unoccupied space temperature shall be monitored by the DDC temperature sensors located in the individual zones being controlled or within a representative room in the building if full DDC control is not being affected.
 4. User shall be able to define, modify or delete the following parameters:
 - a. DNS setpoint temperature(s)
 - b. Temperature band for night heating operation

- c. Period when the DNS is to be activated
- F. Timed Local Override (TLO):
- 1. The system shall be able to have TLO input points which permit the occupants to request an override of equipment which has been scheduled OFF. The system shall turn the equipment ON upon receiving a request from the local input device. Local input devices shall be push-button (momentary contact) at room temperature sensors.
 - 2. The system operator shall be able to define the duration of equipment ON time per input pulse and the total maximum ON time permitted. Override time already entered shall be cancelable by the occupant at the input point.
 - 3. Year-to-date, month-to-date and current day override history shall be maintained for each TLO input point. History data shall be accessible by the operator at any time and shall be capable of being automatically stored on hard disk and/or printed on a daily basis.
- G. Direct Digital Unitary Zone Control:
- 1. The DDC/EMS with the Unitary Zone Control Module shall provide the application software described above; Time of Day Scheduling, Temperature Compensated Duty Cycling, Time of Day Peak Demand Limiting with Temperature Compensation, Trend Logging, Start/Stop Optimization, Reports and Archiving, Source Optimization, Setpoints, Graphic Structure, and Event initiated Programs.
 - 2. The Unitary Zone Control Module shall provide all necessary control strategies (user definable and down loadable from the Central Site) and necessary hardware to control and monitor the VAV Air Terminal Units.
 - 3. The Unitary Zone Control Module for the VAV ATU shall have an on-board differential pressure transducer for monitoring air flow rate.
 - 4. The Unitary Zone Control Module shall interface with the room temperature sensor. The room temperature sensor shall be surface mounted and shall have, in addition to thermistor, a zone local override switch, setpoint adjustment switch, LED indicator for occupied mode.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Protection of Persons and Property:
- 1. Safety Precautions and Programs: The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.
 - 2. Safety of Persons and Property: The Contractor shall take all reasonable precautions and provide all reasonable protection to prevent damage, injury or loss to:
 - a. All employees on the installation sites and all other persons who may be affected.
 - b. All work, materials, and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody, or control of the Controls Contractor or any Subcontractor or Sub-subcontractor.
 - c. Other property at the site or adjacent thereto. The Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders or any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. It shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and

protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

3.2 HARDWARE INSTALLATION:

- A. Utility Company Equipment: Division 26 shall arrange with the utility company for installation of electric billing meters with demand signal pulses. The Contractor shall be responsible for connecting the EMCS to the demand meter. Install conduit and wire.
- B. Interface with Telephone: Provision of a voice-grade telephone line and a phone jack to the central site and LAN is the responsibility of Division 27. The Contractor shall be responsible for communication wiring between the phone jack and the modem/Gateway.
- C. The mounting height of each wall mounted control device shall comply with ADA for maximum side reach. The control device shall be at 48" maximum above the floor.
- D. Electronic Work:
 - 1. The Contractor shall furnish and install all sensing devices, controllers, wiring, and all required accessories for a complete, operational system. Coordinate with the mechanical piping installer for locations of immersion wells, pressure taps, shut off cocks, etc.
 - 2. Power circuit wiring shall be installed in EMT with compression fittings. Set screw or indenter type fitting will not be permitted. Power circuit grounding shall be in accordance with NEC. Ground wire shall be copper.
 - 3. Control or signal circuit wiring shall be in EMT where exposed to the outside environment, where required to prevent mechanical damage and inside all mechanical and electrical rooms. Division 16 will furnish and install junction boxes and EMT from all wall mounted sensors to above the ceiling. The Contractor shall furnish and install all EMT not shown on the electrical plans.
 - 4. Conduit shall be hot-dipped galvanized, standard weight mild steel.
 - 5. All wire shall be stranded copper.
 - 6. A minimum of No. 12 AWG wiring shall be used for all power circuits.
 - 7. All wire and cable insulation shall be rated for 600 volts minimum, unless otherwise specified.
 - 8. Low voltage wire shall be not less than 18 AWG. All line voltage wire shall be THHN/TFFN, 600 volt rated. Maximum voltage shall be 2%.
 - 9. Use cable trays provided by Division 26 as much as possible. Accessible concealed wire run in return air plenums shall meet *NEC 725 (b) code*. All wiring located above ceilings shall be plenum rated.

PART 4 - SEQUENCE OF OPERATION

4.1 GENERAL:

- A. Following are the typical sequences of operation for mechanical equipment. Within each section, each paragraph describes a specific control sequence for a component of the equipment; start/stop, status, etc. Each specific control sequence will require appropriate I/O points.

4.2 VAV AIR HANDLING UNIT (AH-1):

- A. When the AHU is in the Occupied Mode, the supply fan will operate continuously, the outside air and return air dampers will modulate to provide a fixed outside air CFM, and the variable frequency drive will modulate to maintain duct static pressure. When the AHU is in the Unoccupied Mode, the outside air damper will be closed, and the supply fan will operate only when there is a call for cooling or heating from an associated space sensor or upon activation of the AHU local override timer. The AHU will be shut down and alarmed due to the following safeties: smoke detector, freezestat, fan motor failure, VFD failure, and static pressure high limit. The EMCS will remotely monitor and adjust the system static pressure setpoint. The EMCS will remotely monitor and adjust the VFD and fan motor. The EMCS will provide a start/stop signal to the VFD.
- B. Whenever the AHU is "ON", the chilled water valve will modulate to maintain the specified cooling coil discharge air temperature. The chilled water valve will be closed if the AHU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the coil discharge air temperatures. Remote monitoring and alarms shall be provided for mixed air low limit, water valve position, outside air CFM, and filter pressure drop.
- C. Economizer Control: When the outdoor air is cooler than the economizer setpoint, the economizers will act as the initial stage of cooling, working in sequence with the cooling coils. During economizer mode, relief hood dampers shall be opened if space static pressure rises above 0.05" wg.

4.3 TERMINAL UNITS:

- A. Terminal Units shall be electrically interlocked with their respective AHU's. When the space temperature is above the cooling setpoint, the hot water valve will be closed and the air valve will modulate to maintain space temperature. When the space temperature is at or below the cooling setpoint, the air valve will remain at the minimum scheduled airflow. When the space temperature falls below the heating setpoint, the electric reheat shall modulate to maintain space temperature. The air valve actuator and electric reheat will be analog electronic. The DDC controller will have an on-board differential pressure transducer for monitoring air flow rate.
- B. Each TU will go to its minimum airflow setting when the AHU is in the Unoccupied Mode. In high humidity areas, TU's shall also be controlled in response to wall mounted relative humidity sensors. If a sensor detects relative humidity greater than 60%, the associated TU air valve shall slowly move to the maximum airflow position, and the electric reheat shall modulate to maintain the room temperature setpoint. When the relative humidity falls below 60%, the air valve shall slowly revert to its original position.

4.4 SZVAV AIR HANDLING UNIT (AH-2):

- A. When the AHU is in Occupied Mode, the supply fan will operate continuously between maximum and minimum cfm. When the AHU is in the Unoccupied Mode, the supply fan will operate only when there is a call for cooling or heating from an associated space sensor

or upon activation of the AHU local override timer. The AHU will be shut down and alarmed due to the following safeties: fan motor failure. The EMCS will provide a start/stop signal to the motor starter.

- B. The chilled water valve will be closed if the AHU is "OFF". The water valve actuators will be electronic. The EMCS will provide remote monitoring, alarm and setpoint adjustment for the space air temperature and space relative humidity. Remote monitoring shall be provided for water valve position and discharge air temperature. The chilled water valve and electric heat will be staged to maintain the space setpoint air temperature.
- C. When space relative humidity rises above 60%rh, the cooling coil shall modulate to 100% open and the hot water valve shall modulate as needed to maintain space temperature. When the space relative humidity falls back below 55%rh, revert to normal operation.
- D. Outdoor Air Control: In occupied mode, the outside air dampers will be open and shall run continuously to provide the minimum outside air. The return air CO2 sensor will be used to modulate open the outside air dampers to provide CO2 level of 1000 ppm (adj). In unoccupied mode, the outside air dampers will be closed.
- E. Economizer Control: When the outdoor air is cooler than the economizer setpoint, the economizers will act as the initial stage of cooling, working in sequence with the cooling coils. The space CO2 sensor will be used to reset the damper minimum position. During economizer mode, relief hood dampers shall be opened if space static pressure rises above 0.05" wg.

4.5 VARIABLE SPEED PUMPING SYSTEM:

- A. The system shall consist of a pump logic controller, two VFD's and two pumps in parallel for the CHW system.
- B. The pumping system shall start upon the transmission of a digital output "start" signal from the building EMCS. Primary and standby pumps shall automatically exchange positions every seven (7) days.
- C. The pressure sensor/transmitters shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.
- D. The pump logic controller shall compare the pressure signal to the independent, user-determined setpoint.
- E. When all setpoints are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.
- F. The pump logic controller shall continuously scan and compare the process variable to its individual setpoint and control to maintain setpoint.
- G. As the pressure deviates from setpoint, the pump logic controller shall send the appropriate analog signal to the VFD to speed up or slow down the pump/motor.
- H. In the event of primary VFD or pump failure, the standby VFD and pump shall automatically

start and a primary VFD/pump trouble signal shall be sent to the building EMCS.

- I. In the event of failure to receive the process variable signal, the VFD shall maintain 100% speed, and reset shall be automatic upon correction of the failure.
- J. Pump and/or VFD fault shall be continuously scrolled through the display on the operator interface until the fault has been corrected and the pump logic controller has been manually reset.

4.6 CHILLED WATER SYSTEM CONTROL:

- A. The chiller controller shall monitor and control the chillers, pumps, [and cooling tower fans] as directed by the chiller sequencing software. The chiller sequencing software shall perform the following control strategies, provide the points as listed in this section, and support their specified monitoring and diagnostics. The system shall start in response to a binary contact signal from the building EMCS. The chiller sequencing software will start and stop system water pump, chillers, based upon system load. When the chilled water system is enabled, the chiller system control will:
 - 1. Start the system chilled water variable speed distribution pump.
 - 2. Start the lead chilled water production pump and prove flow through the evaporator.
 - 3. Start the lead chiller after the chilled water production pump flow is proven.
- B. The chiller sequencing software shall consider starting another chiller whenever there is deficit flow in the bypass line. The chiller sequencing software shall determine when there is deficit flow by measuring the flow and direction in the bypass line.
- C. When deficit flow exists continuously for an operator-specified length of time, the chiller sequencing software shall initiate the start of the next production pump, [condenser pump] and chiller in the sequence. Lag chillers shall start in a similar manner to the lead chiller start sequence. The chiller sequencing software will unload operating chillers prior to starting a lag chiller.
- D. The chiller sequencing software shall consider stopping another chiller whenever the excess flow in the bypass line exceeds 120 percent of the next off chiller's flow. The chiller sequencing software shall determine the quantity of excess flow by measuring the bypass flow and direction. When the excess flow exceeds 120 percent of the next off chiller's flow continuously for 15 minutes, the chiller sequencing software shall initiate the shutdown of the next production pump, [condenser pump] and chiller in the sequence. The excess flow setpoint and duration shall be easily modifiable by the chiller systems operator. The chiller sequencing software will not shut down the production pump [and condenser pump] until it has confirmed that the chiller compressor has shut down.
- E. The chiller sequencing software shall control individual chiller setpoints to the system supply water temperature setpoint. The system setpoint shall be adjustable by the operator. Chilled water reset shall not be used. Prior to the start of another chiller, all operating chillers shall be unloaded. Following confirmation of the additional chiller operation, all chillers shall be allowed to reload. Upon sensing a chiller failure, the chiller sequencing software shall lockout that chiller and pump and immediately initiate the start of the next chiller in the rotation sequence. Automatic rotation of chiller operation will equalize chiller run time. Rotation shall be initiated based on an operator entered day interval or by the cycling of a

binary point. The method of sequence shall be operator selectable. Chillers may be forced into a new rotation sequence by cycling chillers at the time of initiation. Alternatively, chiller cycling caused by normal system load fluctuations shall cause the chillers to change rotation sequence.

- F. Chiller Soft Start: The chiller sequencing software will provide a user adjustable loading time at system start-up.
- G. Chiller Demand Limiting: As part of the demand limiting scheme on the building, the chiller sequencing software shall be able to monitor and reduce peak power demand through the limiting of chiller system capacity.
- H. Chiller Status Report: Provide an operating status report for each chiller. The report(s) shall provide the present status of all binary information and for analog information present value, today's average, and the month to date average for the following information to provide the operator with critical chiller operating data.
 - 1. Compressor ON/OFF Status
 - 2. Active Chiller Diagnostics of Alarms
 - 3. System Chilled Water Supply Temperature
 - 4. System Chilled Water Return Temperature
 - 5. System Chilled Water Setpoint
 - 6. System Chilled Water Flow (GPM)
 - 7. Chiller Leaving Water Temperature
 - 8. Chiller Entering Water Temperature
 - 9. Chiller Water Setpoint
 - 10. Chiller Water Flow Status
 - 11. KW Limit Status
 - 12. Hot Gas Bypass Status

4.7 SPACE TEMPERATURE CONTROL:

- A. Space Temperature Measurement: There shall be two space temperature setpoints, one for cooling and one for heating, separated by a dead band. Only one of the two setpoints shall be operative at any time.
- B. The cooling setpoint is operative if the actual space temperature has more recently been equal to or greater than the cooling setpoint. The heating setpoint is operative if the actual space temperature has more recently been equal to or less than the heating setpoint.
- C. There are two modes of operation for the setpoints, one for the occupied mode (example: heating = 72 F, cooling = 76 F) and one for the unoccupied mode (example: heating = 55 F, cooling = 90 F).
- D. The occupied/unoccupied modes may be scheduled by time, date, or day of week.

4.8 FAN & HEATER CONTROL:

- A. Fans shall run continuously during Occupied schedule. EMCS shall monitor status and alarm.

B. Electric heaters shall be controlled by integral thermostats and monitored by EMCS.

END OF SECTION 238310

SECTION 239110 - MECHANICAL SOUND, VIBRATION, WIND AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 01 Specifications, apply to this Section.

1.2 SCOPE OF WORK:

- A. Furnish all labor, materials, tools, and equipment and perform all work necessary to complete the installation of the mechanical sound, vibration, wind, and seismic control systems required by these specifications and as detailed on the drawings.
- B. All foundations and supports required for the installation of Division 23 equipment shall be furnished by the Division 23 contractor shall unless specifically specified otherwise.
- C. The following criteria applies to all mechanical systems and components:
 - 1. Wind Pressure Velocity: 141 MPH
 - 2. Seismic Design Category: B
 - 3. Importance Factor: 1.0
- D. Based on the criteria listed above, seismic restraints are not required.

1.3 QUALITY ASSURANCE:

- A. Codes and Standards: The installation of the mechanical systems shall be installed in accordance with the following codes and standards.:
 - 1. *2018 International Building Code (IBC)*
 - 2. *ASHRAE*
- B. The mechanical sound, vibration, and wind control equipment and products shall be sized and provided by the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.
- C. *Kinetics Noise Control* is the Basis of Design manufacturer. Equivalent name brand equipment by *AeroSonics, Aladdin, IAC Acoustics, Mason, MGM Products, Vibration Eliminator, Vibro-Acoustics, and Vibration Mountings and Controls* that meets performance, capacity, space and other requirements of the design documents shall be acceptable.
- D. The manufacturer and/or his representative shall select all vibration isolation products in accordance with the Vibration Isolation Schedule listed in these specifications. All products shall provide the specified deflection as indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide installation instructions for all provided isolators and wind restraints. Locations of vibration isolation products shall be coordinated with equipment details shown on the drawings and as

specified in these specifications for maximum support locations for piping and other equipment.

E. Submittals:

1. The contractor shall submit for approval by the engineer all products intended to be used to meet the requirements of these specifications. Submittal data shall include a proposed schedule for vibration isolation products, manufacturer's data and cut sheets of the specific vibration isolation, or sound barrier materials. Proposed Vibration Isolation Schedule shall list all equipment specified to be isolated, the equipment weight, proposed isolator type or base type, number of isolators required, spring or isolator color, and deflection of the spring or vibration isolator based on the equipment weight.
2. The contractor shall submit for approval by the engineer, wind anchorage requirements for all equipment and curbs. Anchorage calculations shall be prepared by a registered engineer in the state where the project will be constructed. The engineer shall stamp calculations. Wind anchorage requirements shall be submitted for all curb mounted equipment and roof mounted equipment. Fasteners shall be selected and detailed for curb connections to the building structure and for equipment connections to the curb. Calculations shall be based on the approved equipment for the project.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein or as detailed on the drawings.
- B. The vibration isolation products and systems shall have a deflection as recommended by the manufacturer but not less than the deflection indicated in the Vibration Isolation Schedule.

2.2 ISOLATOR TYPES:

- A. Type 2 - Floor Mounted Equipment: Vibration isolators shall be neoprene, molded from oil-resistant compounds. Isolators shall consist of two layers of neoprene material. Top and bottom surfaces of each layer shall have molded ribs. Each layer shall be separated by a 16-gauge galvanized steel load plate bonded to each neoprene layer to form a sandwich arrangement. Vibration isolator size shall be coordinated with the equipment supports. Minimum size shall be 2"x2".
- B. Type 4 - Floor-Mounted Equipment: Vibration isolators shall be free standing, un-housed, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs, springs shall be replaceable. In capacities over 5,000 lbs, springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a

non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.

- C. Type 8 - Suspended Equipment and Ductwork: Vibration isolators shall be hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit.

- D. Type 10 - Suspended Equipment, Piping and Ductwork: Vibration Isolators shall consist of a steel spring and neoprene element in series mounted in a stamped or welded steel bracket for insertion into the hanger rod assembly. The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color coded to indicate load capacity and selected to operate within its published load range. The steel spring shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit movement. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. The steel bracket shall be fabricated from steel and provided with a corrosion resistance finished. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. The hanger bracket shall incorporate spring caps with indexed steps, which correspond to the washer diameter of the hanger rod to keep the rod centered in the spring cap.

- E. Type 11 - Suspended Equipment, Piping and Ductwork: Vibration Isolators shall consist of a steel spring and fiberglass element in series mounted in a stamped or welded steel bracket for insertion into the hanger rod assembly. Fiberglass element shall be a pre-compressed molded fiberglass pad coated with a flexible, moisture impervious elastomeric membrane. Vibration isolation pad shall be molded from glass fibers with fiber diameters not exceeding .00027" and with a modulus of elasticity of 10.5 million psi. Natural frequency of fiberglass pad shall be essentially constant for the operating load range of the supported equipment. Fiberglass pad shall be color coded or otherwise identified to indicate the load capacity. The steel spring shall consist of large diameter laterally stable steel springs assembled into formed or welded steel housing assemblies designed to limit movement. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. The steel bracket shall be fabricated from steel and provided with a corrosion resistance finished. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. The hanger bracket shall incorporate spring caps with indexed steps, which correspond to the washer diameter of the hanger rod to keep the rod centered in the spring cap.

2.3 VIBRATION ISOLATION SCHEDULE FOR MECHANICAL SYSTEMS:

<u>Equipment Type</u>	<u>Isolator Type</u>	<u>Base Type</u>	<u>Deflection</u>
Floor Mounted AHU	Type 2	Slab	0.2"

Air Cooled Chiller	Type 2	Slab	0.2"
Mechanical Room Piping	Type 10	None	1.0"
Mechanical Room Ductwork	Type 8	None	0.4"
Fan Powered ATU	Type 10	None	1.0"

PART 3 - EXECUTION

3.1 GENERAL:

- A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation or seismic restraints as specified herein.
- B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.
- C. All equipment specified to be isolated shall be installed and isolators shall be attached to the building structure or floor and the vibration isolators shall be adjusted and leveled so that the vibration isolators are performing properly.
- D. All vibration isolation products, seismic restraint products, flexible pipe connectors and sound control products shall be installed as outlined in the manufacturer's printed installation instructions.
- E. For equipment scheduled to receive external vibration isolation, all factory-installed internal vibration isolation shall be locked down.

END OF SECTION 239110

SECTION 239210 - MECHANICAL TESTING, ADJUSTING, BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. General: An independent test agency shall perform the TAB work as described herein. The agency shall have a minimum of 3 years of successful TAB experience on projects of similar size and scope. The name of the test agency and proof of satisfactory performance on 5 previous projects in the form of projects referenced shall be submitted to the Design Professional for approval within 30 days after receipt of the construction contract.
- B. Test Agency: A firm with membership in the *Associated Air Balance Council (AABC)* or certified by the *National Environmental Balancing Bureau (NEBB)* in those testing and balancing disciplines similar to those required for this project, who is not the Installer of the system to be tested and is otherwise independent of the project.
- C. Compliance: Comply with *AABC* standards or *NEBB Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems* as applicable to mechanical air systems and associated equipment apparatus.
- D. Industry Standards: Comply with *ASHRAE (American Society for Heating, Refrigeration and Air Conditioning Engineers, Inc.)* recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing except as otherwise indicated.
- E. Pre-Qualified TAB Agencies: Subject to compliance with requirements, engage one of the following the following certified Test and Balance Agencies:
 1. *Air Analysis of Atlanta*
 2. *Augusta Air Balance Company*
 3. *Air Data Macon GA*
 4. *Commissioning Services LLC.*
 5. *Georgia Balance Company*
 6. *Research Air Flo, Inc.*
 7. *TAB Services*
 8. *Thomas Balancing*
 9. *Palmetto Air & Water Balance*

1.3 SUBMITTALS:

- A. Submit name of TAB Agency for approval within 60 days after Notice to Proceed.
- B. Submit (5) copies of a certified test report signed by the TAB supervisor who performed the

TAB work. Test reports shall be submitted prior to the final inspection of mechanical work.

1. Include identification and types of instruments used and their most recent calibration date with submission of final test report.
2. In addition to Air Balance and operational data required to be submitted, the report shall include any observation of unusual noise or vibration observed and any malfunction of adjustable devices encountered during TAB work.

C. Submit *AABC National Performance Guaranty* or *NEBB Certificate of Conformance Certification* for the project.

1.4 JOB CONDITIONS:

- A. Do not proceed with testing, adjusting and balancing work until mechanical systems are complete and operable. Do not proceed until systems are clean and free from debris, dirt, and discarded building materials.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS:

- A. Except as otherwise indicated, use the same products as used by original Installer for patching holes in insulation, ductwork and housing which may have been cut or drilled for test purposes, including access for test instruments, attaching jigs and similar purposes.

2.2 TEST INSTRUMENTS:

- A. Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended in *AABC* standards or *NEBB* Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems.

PART 3 - EXECUTION

3.1 SCOPE:

- A. Test, Adjust, and Balance the following:
 1. Ductless Heat Pumps and Air Handlers
 2. Electric Heaters
 3. Fans
 4. Air Inlets and Outlets
 5. Pumps
 6. Chillers
 7. Air Handling Units
 8. Terminal Units
 9. Fan Coil Units

3.2 GENERAL REQUIREMENTS:

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR-82-2001
PERMIT SUBMITTAL
APRIL 2024

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- A. Perform total system balance in accordance with one of the following:
 - 1. *AABC, AABC National Standards for Total System Balance.*
 - 2. *NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.*
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work and submit Report prior to the Final Observation of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. Reports shall be certified by an *AABC Certified Test and Balance Engineer* or *NEBB Certified Testing, Balancing, and Adjusting Supervisor* experienced in performance of this Work.

3.3 EXAMINATION:

- A. Review the contract documents for appurtenances and arrangement for balancing prior to the installation of any equipment or material. These shall include gauges, test plugs, valves, air volume balancing dampers, etc. The contractor shall be responsible for providing these in the locations recommended by the TAB agency in addition to any shown on the drawings or specified. Verify that duct layout design allows the TAB agency to perform duct pitot traverses to verify system air flows.
- B. The Contractor shall notify the Design Professional of any omissions noted within 30 days of the Contractor's notice to proceed.
- C. Verify that airside and hydronic systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. All filters are clean and in place. If required, install temporary media in addition to filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place, accessible, operable, and open. Report observation on test report.
 - 8. All dampers and operators function smoothly from shut-off to full open.
 - 9. Air coil fins are cleaned and combed.
 - 10. Access doors are installed at specified components are accessible, are closed and duct end caps are in place.
 - 11. Air outlets are installed and connected.
 - 12. Duct system leakage is minimized.
 - 13. Piping is complete with all terminals installed.
 - 14. Water treatment is complete.
 - 15. Systems are flushed, filled and air purged.
 - 16. Strainers are pulled and cleaned.
 - 17. Control valves are functioning per the sequence of operation.
 - 18. All shutoff and balance valves have been verified to be 100% open.
 - 19. Pumps are started, and proper rotation is verified.

20. Pump gauge connections are installed directly at the pump inlet and outlet flange or in discharge and suction pipe prior to any valves or strainers.
 21. VFD start-up is complete and all safeties have been verified for airside and hydronic systems.
- D. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3.4 INSTALLATION TOLERANCES:

- A. Air Systems: Set HVAC system's air flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10%.
 2. Air Outlets and Inlets: Plus or minus 10%.
- B. Hydronic Systems: Set HVAC system's water flow rates within the following tolerances:
1. Heating Water Flow Rate: Plus or minus 10%.
 2. Cooling Water Flow Rate: Plus or minus 10%.
 3. Condenser Water Flow Rate: Plus or minus 10%.
- C. Building Pressure: Ensure that installation tolerances result in each floor of the building being positively pressurized with respect to outside ambient pressure.

3.5 RECORDING AND ADJUSTING:

- A. Field Logs: Maintain written logs including:
1. Running logs of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed task.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark setting of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 FINAL TEST AND BALANCE REPORT:

- A. The report shall be a complete record of the HVAC system performance in heating and cooling modes, including conditions of operation, items outstanding, and any deviations found during the TAB process. The final report also provides a reference of actual operating

conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the TAB technicians or test and balance engineers. Report shall contain test results, including instrumentation calibration reports, in the form recommended by the applicable standards.

- B. The report must be organized by systems and shall include the following information as a minimum:
 1. Title Page:
 - a. Certified company name
 - b. Company address
 - c. Company telephone number
 - d. Project identification number
 - e. Location
 - f. Project Design Professional
 - g. Project Engineer
 - h. Project Contractor
 - i. Project number
 - j. Date of report
 - k. *AABC* or *NEBB* Certification Statement
 - l. Name, signature, and certification number of *AABC TBE* or *NEBB Qualified TAB Supervisor*.
 2. Table of Contents.
 3. *AABC National Performance Guaranty* or *NEBB Certificate of Conformance Certification*.
 4. Report Summary:
 - a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
 5. Instrument List:
 - a. Type
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Calibration Date
 6. Test and Balance Data:
 - a. Provide test data for specific systems and equipment as required by the most recent edition of the *AABC National Standards* or *NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems*.

3.7 MINIMUM REQUIRED TEST DATA FOR SYSTEMS:

- A. The following test data shall be submitted for each system type in addition to what is required by the *AABC National Standards* or *NEBB Procedural Standards for Testing Adjusting and Balancing of Environmental Systems*.
- B. Ductless Heat Pumps and Air Handlers:

1. Identification/ Number.
 2. Manufacturer model number and serial number of indoor and outdoor units.
 3. Design and actual supply airflow.
 4. Design and actual outside airflow.
 5. Cooling mode: design entering and leaving air DB/WB.
 6. Cooling mode: actual entering and leaving air DB/WB. (w/ concurrent OA temp)
 7. Heating mode: design entering and leaving air DB.
 8. Heating mode: actual entering and leaving air DB. (w/ concurrent OA temp)
 9. Verification that air treatment device is installed and operational.
 10. Record all notes pertinent to the test.
- C. Electric Heaters:
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Design supply airflow.
 4. Heating coil: design entering and leaving air DB.
 5. Heating coil: actual entering and leaving air DB.
 6. Design and calculated kW.
 7. Record all notes pertinent to the test.
- D. Fans:
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Design and actual fan airflow, RPM, voltage, amperage, ESP and Total SP.
 4. Fan sheave and belt data.
- E. Air Distribution Tests:
1. Air terminal number.
 2. Room number/ location.
 3. Terminal type and size.
 4. Design air flow.
 5. Actual (final) air flow.
 6. Percent of design air flow.
 7. Relative position of balancing damper.
- F. Duct Traverses:
1. System zone/ branch.
 2. Duct size.
 3. Area.
 4. Design velocity and air flow.
 5. Actual velocity and air flow.
 6. Duct static pressure.
 7. Air correction factor.
- G. Space Temperature and Humidity:
1. Temperature and relative humidity (whether controlled or not) of each conditioned space.
 2. Set point of each controlling thermostat or humidity sensing device.
- H. Pumps:
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Motor model number and serial number.

4. Motor horsepower, frame size, full load amps, and service factor.
 5. Motor voltage and phase and actual operating voltage.
 6. Motor nameplate amps, corrected amps, and actual operating amps.
 7. Design and actual motor rpm.
 8. VFD setting for Min and Max waterflow in Hz.
 9. Installed impeller diameter.
 10. Verification of proper impeller rotation.
 11. Design and actual waterflow.
 12. Shutoff suction pressure in psi and ft. hd.
 13. Shutoff discharge pressure in psi and ft. hd.
 14. Shutoff design and actual total dynamic head in psi and ft. hd
 15. Final suction pressure in psi and ft. hd.
 16. Final discharge pressure in psi and ft. hd.
 17. Final design and actual total dynamic head in psi and ft. hd.
 18. Hydronic system ΔP setpoint.
 19. Record all notes pertinent to the test.
- I. Chillers (Air Cooled):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Evaporator: Design and actual waterflow.
 4. Evaporator: Design inlet and outlet water temperatures.
 5. Evaporator: Actual inlet and outlet water temperatures. (w/ concurrent OA temp)
 6. Evaporator: Design and actual pressure drop.
 7. Design and calculated tonnage.
 8. Condenser fan quantity and motor data.
 9. Verification of condenser fan(s) proper rotation.
 10. Record all notes pertinent to the test.
- J. Air Handling Units (AHU):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Motor model number and serial number.
 4. Motor horsepower, frame size, full load amps, and service factor.
 5. Motor voltage and phase and actual operating voltage.
 6. Motor nameplate amps, corrected amps, and actual operating amps.
 7. Design and actual motor and fan rpm.
 8. Installed wheel type and diameter.
 9. Supply fan sheave and belt data.
 10. Verification of proper wheel rotation.
 11. Filter quantity, size, type, and condition.
 12. Design and actual Max supply fan airflow, ESP and Total SP.
 13. Design and actual Min supply fan airflow.
 14. Design and actual outside airflow. (@ max and min airflow)
 15. VFD setting for Min and Max airflow in Hz.
 16. System ΔP setpoint.
 17. System static pressure profile.
 18. Heating coil: design entering and leaving air DB.
 19. Heating coil: actual entering and leaving air DB. (@ heating airflow)
 20. Cooling coil: design entering and leaving air DB.
 21. Cooling coil: actual entering and leaving air DB. (@ min and max airflow)

22. Design and actual waterflow for each coil. (measured from Flow Verification Device)
 23. Design inlet and outlet water temperatures for each coil.
 24. Actual inlet and outlet water temperatures for each coil.
 25. Design and actual coil pressure drop for each coil.
 26. Automatic Flow Control Device manufacturer, type, and size for each coil.
 27. Automatic Flow Control Device design and actual pressure drop for each coil.
 28. Flow Verification Device manufacturer, type, and size for each coil.
 29. Flow Verification Device design and actual pressure drop for each coil.
 30. Verification that air treatment device is installed and operational.
 31. Record all notes pertinent to the test.
- K. Terminal Units (Single Duct Hot Water Coil):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Design and actual Max cooling airflow.
 4. Design and actual Min cooling airflow.
 5. Design and actual heating airflow.
 6. Flow correction value.
 7. Heating coil: design entering and leaving air DB.
 8. Heating coil: actual entering and leaving air DB. (@ heating airflow)
 9. Design and actual waterflow.
 10. Design inlet and outlet water temperatures.
 11. Actual inlet and outlet water temperatures.
 12. Design and actual coil pressure drop.
 13. Automatic Flow Control Device manufacturer, type, and size.
 14. Automatic Flow Control Device design and actual pressure drop.
 15. Flow Verification Device manufacturer, type, and size.
 16. Flow Verification Device design and actual pressure drop.
 17. Record all notes pertinent to the test.
- L. Terminal Units (Single Duct Electric Reheat Coil):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Design and actual Max cooling airflow.
 4. Design and actual Min cooling airflow.
 5. Design and actual heating airflow.
 6. Flow correction value.
 7. Heating coil: design entering and leaving air DB.
 8. Heating coil: actual entering and leaving air DB. (@ heating airflow)
 9. Design and calculated heater kW.
 10. Record all notes pertinent to the test.
- M. Terminal Units (Fan Powered Electric Reheat):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Motor model number and serial number.
 4. Motor horsepower, full load amps, and service factor.
 5. Motor voltage and phase and actual operating voltage.
 6. Motor nameplate amps, corrected amps, and actual operating amps.
 7. Design and actual motor rpm.
 8. Verification of proper wheel rotation.

9. Design and actual Max cooling airflow.
 10. Design and actual Min cooling airflow.
 11. Design and actual fan airflow.
 12. Design and actual heating airflow.
 13. Flow correction value.
 14. Heating coil: design entering and leaving air DB.
 15. Heating coil: actual entering and leaving air DB. (@ heating airflow)
 16. Design and calculated heater kW.
 17. Record all notes pertinent to the test.
- N. Fan Coil Units (FCU):
1. Identification/ Number.
 2. Manufacturer model number and serial number.
 3. Motor model number and serial number.
 4. Motor horsepower, full load amps, and service factor.
 5. Motor voltage and phase and actual operating voltage.
 6. Motor nameplate amps, corrected amps, and actual operating amps.
 7. Design and actual motor rpm.
 8. Installed wheel type and diameter.
 9. Supply fan sheave and belt data.
 10. Verification of proper wheel rotation.
 11. Filter quantity, size, type, and condition.
 12. Design and actual airflow, ESP and Total SP.
 13. Heating coil: design entering and leaving air DB.
 14. Heating coil: actual entering and leaving air DB.
 15. Cooling coil: design entering and leaving air DB.
 16. Cooling coil: actual entering and leaving air DB.
 17. Design and actual waterflow for each coil.
 18. Design inlet and outlet water temperatures for each coil.
 19. Actual inlet and outlet water temperatures for each coil.
 20. Design and actual coil pressure drop for each coil.
 21. Automatic Flow Control Device manufacturer, type, and size for each coil.
 22. Automatic Flow Control Device design and actual pressure drop for each coil.
 23. Flow Verification Device manufacturer, type, and size for each coil.
 24. Flow Verification Device design and actual pressure drop for each coil.
 25. Verification that air treatment device is installed and operational.
 26. Record all notes pertinent to the test.
- O. Energy Management Controls System Verification:
1. Confirm that the sequences of operation comply with the approved drawings.
 2. Verify that controllers are calibrated and function as intended.
 3. Verify that controller setpoints are as specified.
 4. Verify the operation of lockout or interlock systems.
 5. Verify the operation of all valve and damper actuators.
 6. Verify that all controlled devices are properly installed and connected to the correct controller.
 7. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
 8. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidities, or pressures.

3.8 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check condensate drains for proper connections and functioning.
- G. Check for proper sealing of air-handling-unit components.

3.9 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS:

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 - 3. 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.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust sub-main and branch duct volume dampers for specified airflow.

- C. Re-measure each sub-main and branch duct after all have been adjusted.
 - 1. Adjust air inlets and outlets for each space to indicated airflows.
 - 2. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 3. Measure airflow at all inlets and outlets.
 - 4. Adjust each inlet and outlet for specified airflow.
- D. Re-measure each inlet and outlet after all have been adjusted.
- E. Verify final system conditions.
- F. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
- G. Re-measure and confirm total airflow is within design.
- H. Re-measure all final fan operating data, rpms, volts, amps, static profile.
- I. Mark all final settings.
- J. Test system in economizer mode. Verify proper operation and adjust, if necessary.
- K. Measure and record all operating data.
- L. Record final fan-performance data.

3.10 PROCEDURES FOR VARIABLE AIR VOLUME SYSTEMS:

- A. Adjust the variable-air-volume systems as follows:
 - 1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge.
 - 2. Verify that the system is under static pressure control.
 - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

- f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
- g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify all terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
 - b. Re-measure and confirm total airflow is within design.
 - c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
 - d. Mark all final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return fans.

3.11 AIR SYSTEM PROCEDURE:

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse if entire cross-sectional area of duct. Close openings after measurement with permanent manufactured plugs.

- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.
- F. Vary total system air quantities by adjustment of fan speeds by drive sheave adjustment. Provide drive changes required to place belt in mid-position at final RPM. Vary branch air quantities by damper regulation.
- G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust operators on outside air dampers to ensure tight seal when shut.
- H. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.12 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS:

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Verify that hydronic systems are ready for testing and balancing:
 - 1. Check liquid level in expansion tank.
 - 2. Check that makeup water-has adequate pressure to highest vent.
 - 3. Check that control valves are in their proper position.
 - 4. Locate start-stop and disconnect switches, electrical interlocks, variable frequency drives, and motor starters.
 - 5. Verify that motor starters are equipped with properly sized thermal protection.
 - 6. Check that air has been purged from the system.

3.13 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS:

- A. Adjust pumps to deliver total design gpm.
 - 1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed determine flow by pump total dynamic head (TDH) or exchanger pressure drop.
 - 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.

- d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - e. With all valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow measuring devices installed in mains and branches to design water flows.
- 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow measuring devices installed at terminals for each space to design water flows.
- 1. Measure flow at all terminals.
 - 2. Adjust each terminal to design flow.
 - 3. Re-measure each terminal after all have been adjusted.
 - 4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
 - 5. Perform temperature tests after all flows have been balanced.
- D. For systems with pressure-independent valves at the terminals:
- 1. Measure differential pressure and verify that it is within manufacturer's specified range.
 - 2. Perform temperature tests after all flows have been verified.
- E. For systems without pressure-independent valves or flow measuring devices at the terminals:
- 1. Measure and balance coils by either coil pressure drop or temperature method.
 - 2. If balanced by coil pressure drop, perform temperature tests after all flows have been verified.
- F. Verify final system conditions as follows:
- 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure all final pumps' operating data, TDH, volts, amps, static profile.
 - 3. Mark all final settings.
- G. Verify that all memory stops have been set.

3.14 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS:

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
- 1. Verify that the differential-pressure sensor is located per the contract documents.
 - 2. Determine if there is diversity in the system.
- C. For systems with no diversity:
- 1. Follow procedures outlined in *Procedures for Constant-Flow Hydronic Systems* article.

2. Prior to verifying final system conditions, determine the system differential-pressure set point.
 3. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
 4. Mark all final settings and verify that all memory stops have been set.
- D. For systems with diversity:
1. Determine diversity factor.
 2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
 3. Follow procedures outlined in *Procedures for Variable-Flow Hydronic Systems* article.
 4. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity and balance the terminals that were just opened.
 5. Prior to verifying final system conditions, determine the system differential-pressure set point.
 6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100% and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
 7. Mark all final settings and verify that all memory stops have been set.

3.15 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS:

- A. Follow general procedures for hydronic systems.
- B. Balance the primary circuit flow first.
- C. Balance the secondary circuits after the primary circuits are complete.

3.16 TESTING:

- A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjusting-balancing work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to Tester.
- B. Airflows shown on drawings are provided as a guide to achieve uniform room temperature throughout the building. Field correct as required to suite room condition. Any substantial alteration shall be called to the engineer's attention.

END OF SECTION 239210

SECTION 260100 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 IMPOSED REGULATIONS:

- A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:
 1. *NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.*
 2. *The Life Safety Code (NFPA No. 101), with Georgia Amendments.*
 3. *State of Georgia ADA Accessibility Guidelines for Building and Facilities.*
 4. *The International Building Code, with Georgia Amendments.*
 5. *The National Electrical Safety Code (ANSI C2.)*
 6. *UL Fire Resistance Directory.*
 7. *UL Electrical Construction Materials Directory.*
 8. *UL Electrical Appliance and Utilization Equipment Directory.*

1.3 SCOPE OF WORK:

- A. Provide all labor, materials, equipment and supervision to construct complete and operable electrical systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.

1.4 COORDINATION:

- A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by Owner, where applicable.

1.5 PROJECT STAFFING:

- A. Superintendent:
 1. Provide a superintendent to plan, layout, supervise and coordinate the work provided by all organizations providing work under Division 26. The superintendent shall be at the job site at any time work is being performed.
 2. The superintendent shall have a minimum of 5 years of experience in projects of similar size and scope. The superintendent shall have a State of Georgia unrestricted electrical contractor's license.
- B. Organizations Furnishing and Installing Electrical Systems:
 1. Traditional electrical systems work shall be furnished and installed by organizations who

have successfully completed work of similar size and scope, and who have been in business for at least 3 years.

2. Electricians, 600V and below:
 - a. Electricians assigned to the project shall have proof of having completed a formal training program which certifies that they are qualified to perform electrical work of the type encountered on this project and are familiar with the building codes which apply to this project. For the purposes of this project, workers not possessing these qualifications shall be considered helpers and shall not be allowed to perform electrical work.
 3. Electricians, above 600V:
 - a. Installation of primary cable systems (15 kV class) shall be supervised by a person having not less than five (5) years experience as a supervisor in the installation of electric utilities - 15 kV class.
 - b. All primary cable terminations and splices shall be made by a cable splicer having not less than five (5) years experience in splicing cables and making terminations of the type specified herein on systems with rated voltage not less than the primary system specified.
- C. Organizations Furnishing and Installing Specialty Systems:
1. Specialty Systems Technicians
 - a. Work specified in Sections 265000 (Lightning Protection Systems) shall be installed, and tested by factory trained technicians in the employ of the manufacturer or manufacturer's authorized representative.
- D. Submit resumes for review and approval by the Design Professional prior to proceeding with any work on the project. Fill out Attachment 2, Section 260120 for each firm providing work under Division 26.

1.6 UTILITY CONNECTIONS:

- A. The approximate point of origination for electric, telephone and television utilities is shown on the drawings. However, the contractor shall confirm the location with the respective utility prior to ordering materials or beginning any trenching. The Contractor's bid shall allow for the service point to be shifted by the utility, 25'feet in any direction from that shown.

1.7 PERMITS AND TEST; ELECTRICAL WORK:

- A. Submit a record copy (for Owner's records) of electrical work notices, permits, licenses, inspection or test reports, and similar items obtained in response to governing and imposed codes, regulations and standards.

1.8 ELECTRICAL DRAWINGS:

- A. Do not scale the electrical drawings. Obtain all dimensions from the Design Professional's dimensioned drawings, field measurements and shop drawings.
- B. Electrical contract drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. Review product data sheets, wiring diagrams,

manufacturer's installation instructions, etc. and provide the connections required to place equipment into service. Do not rely solely on the conductor counts shown on the drawings.

- C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Design Professional. **The specifications do not override the drawings or vice-versa.**

1.9 EQUIPMENT REQUIRING ELECTRICAL SERVICE:

- A. Provide connections for all electrically driven equipment, in accordance with the electrical drawings and the division of the specifications in which the equipment is specified.
 - 1. Connection shall include circuit breaker, wiring, control and disconnecting means (where applicable) and final connection.
 - 2. Prior to ordering materials, review approved shop drawings of equipment that will be ordered and verify the connections shown. Fill out and submit the Coordination Affidavit required by Section 260120.
 - 3. Where connection is required by other Divisions, but no connection is shown on the electrical drawings, provide connection to nearest panel of same voltage and phase based on the characteristics shown on other drawings. All added connections shall be brought to the attention of the Design Professional.
 - 4. Provide 120 volt, 1 phase, 20 ampere power connection for all Division 23 control panels, whether indicated on the project drawings or not. Circuit from nearest 120/208 volt, 3 phase, 4 wire panelboard from available 20 amp, single-pole spares. Revise panelboard schedules accordingly. Document and coordinate control panel requirements and locations during preparation of the Coordination Affidavit, Attachment No. 1.

1.10 SYSTEMS REQUIRING ROUGH-IN:

- A. Rough-in shall consist of all outlet boxes and covers/raceway systems/supports and sleeves required for the installation of cables/devices specified by other Divisions and by the Using Agency.
- B. Review shop drawings to determine rough-in requirements; do not rely solely on the information shown on the drawings. Keep a copy of these shop drawings at the project site throughout the course of construction.
- C. Systems requiring rough-in shall include, but not be limited to the following:
 - 1. Mechanical equipment as shown in Divisions 22 and 23
 - 2. Building equipment as shown
 - 3. Equipment furnished by the Using Agency as shown on plans
 - 4. Telephone service entrance
 - 5. Television cable service entrance
 - 6. Voice / data / video cabling systems.
- D. Rough-in requirements are further defined in Section 261010. Prior to performing any rough-in, meet with the designated representative of the trade involved to confirm device locations, mounting heights, trim ring type and orientation.

1.11 PERFORMANCE TESTING:

- A. Testing specified in other sections shall be performed by authorized representatives of the system manufacturer, scheduled and paid for by the Contractor.
 - 1. The contractor shall provide personnel, tools and equipment necessary to conduct the tests.
 - 2. Provide three copies of all test results. For each system, include a cover page with the Testing Agency letterhead, name of persons conducting the test, date(s) of tests, and an executive summary of the testing performed. Include the detailed results after this summary.
- B. Notify the Design Professional in writing 48 hours in advance of any testing to be performed. Include the system or systems to be tested. The purpose of this requirement is to allow the Design Professional and Using Agency time to schedule representatives to be present.
- C. Schedule the work so that all tests can be conducted at one time.
- D. Provide personnel and equipment necessary to make all work accessible to the testing agency.
- E. A copy of the test reports will be made available to the contractor. The contractor shall remove and replace all work that does not meet specified performance parameters. The contractor shall bear the expense of retesting systems.

1.12 RECORD DOCUMENTS:

- A. The electrical superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:
 - 1. Post all addenda prior to beginning work.
 - 2. Post all changes in the work.
 - 3. Document actual feeder conduit routes, both interior and exterior. For lines run below grade or slab, dimension lines off of fixed surfaces.
 - 4. Scope of each change order (C.O.), noting C.O. number.
 - 5. Mark up all branch circuit connections.

1.13 RECORD MANUALS: (CLOSEOUT REQUIREMENTS)

Record manuals shall include the following:

- A. Manufacturer's operation and maintenance manuals for:
 - 1. Lighting Fixtures
 - 2. Lighting Contactors
 - 3. Lighting Control System.
 - 4. Motor Starters
 - 5. Panelboards and circuit breakers
 - 6. Switchboards (Include manufacturer's fabrication drawings)
 - 7. Pad Mounted Transformers (Include manufacturer's fabrication drawings)

- 8. Dry Type Transformers
- 9. Emergency Power System (Include manufacturer's fabrication drawings)

- B. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*
- C. One copy of all panelboard directories plus USB flash drive with electronic spreadsheets containing directories.
- D. Lightning Protection System layout drawings updated to reflect as-built conditions.
- E. Emergency Power System connection drawings updated to reflect as-built conditions.
- F. Exterior lighting control system wiring diagrams updated to reflect as-built conditions.
- G. All test results listed by specification section.
- H. All required keys, tools, and spare parts.
- I. Submit record manuals in quantities and in the format prescribed in the Division specifications, plus one copy for the Engineer.

1.14 TRAINING OF OWNER'S FORCES:

- A. Train Owner's personnel on the operation and maintenance of the following systems :
 - 1. Exterior Lighting Control System - 2 hours.
 - 2. Tour of Facility - 8 hours
- B. The "tour of facility" shall consist of the walk-thru of at least one space of each type. The Division 26 Superintendent shall demonstrate operation of all lighting controls, emergency shut off controls, use of receptacles, etc. The tour shall be conducted jointly with Division 27.
- C. Training shall not be conducted until system has been tested by the Contractor and is 100% operational. Training shall be conducted at the project site.
- D. As a minimum, the following materials shall be reviewed during the training session:
 - 1. Owner's operation and maintenance manual.
 - 2. Corrected shop drawings and as-built system drawings.
 - 3. Hands-on demonstration of system features and operation.
- E. Schedule the training at least two weeks in advance. At that time, provide a detailed outline of the training session.
- F. Training shall be conducted by authorized representatives of the system manufacturer and the Division 27 superintendent.
- G. The contractor shall make a video (DVD format) of all training sessions and deliver to the Owner.

1.15 REVIEW OF THE WORK BY THE DESIGN PROFESSIONAL:

- A. During the course of the project, the work will be reviewed by a representative of the Design Professional. Upon each visit, the Contractor shall also demonstrate that the record documents and shop drawing files are being kept current. The Division 26 Superintendent shall accompany the Design Professional on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.
- B. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.
- C. Construction review reports will be issued by the Design Professional for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report has been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Refer to the drawings and individual specification sections for requirements.
- B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract documents and order equipment based on intended use.

2.2 MATERIALS:

- A. All materials and equipment used shall be new, undamaged and free from any defects.
- B. Provide materials and equipment that are *UL* listed, unless listing is unavailable.
- C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.
- D. It is the responsibility of the Contractor to determine the shipping splits for large equipment.
- E. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use. Products not listed in these specifications or shown on drawings shall not be used.

2.3 ACCEPTABLE MANUFACTURERS:

- A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 1 and the paragraph "B" below.
- B. Requests for prior approval (i.e. before the bid opening) must contain all information listed for the specific item in Section 260120, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Design Professional's office no later than ten working days prior to the opening of bids. **Requests that are incomplete or are sent by facsimile will not be reviewed.**

PART 3 - EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

- A. The Division 26 Superintendent's duties shall include, but not be limited to the following:
 - 1. Preparation of submittals.
 - 2. Planning and layout of the work.
 - 3. Coordination with other trades and the local utility company.
 - 4. Posting addenda and changes in the work to maintain the Record Documents and to ensure that Division 26 personnel are working from up-to-date drawings and specifications.
 - 5. Supervision of all Division 26 personnel.
 - 6. Ongoing review of work in place to ensure compliance with the Contract Documents.
 - 7. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 01 specifications.
 - 8. Training of the Owner's personnel.

3.2 PROTECTION OF THE WORK:

- A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.
- B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.
- C. Prior to the building being "dried-in", protect incomplete conduit runs, outlet boxes, equipment enclosures, etc. from the entry of water or construction debris, by installing and maintaining temporary protective covers.
- D. Do not install wiring devices, equipment or panel interiors until the building is dried-in. For the purposes of this specification "dried in" shall mean the roof has been installed, all exterior openings are covered and the interior of the building is dry.
- E. Maintain temporary protective covers over equipment enclosures, outlet boxes and similar

- items after interiors, conductors, devices, etc. are installed, to prevent the entry of construction debris and to protect the installation during finish work performed by others. Do not install device plates, equipment covers or trims until finish work is complete.
- F. Install temporary protective covers over equipment mounted on the building exterior to prevent corrosion damage during cleaning of the building exterior, by others.
 - G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.
 - H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.
 - I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 CUTTING AND PATCHING:

- A. Structural Limitations: Do not cut structural framing, walls, floors, decks, and other members intended to withstand stress, except with the Design Professional's written authorization. Authorization will be granted only when there is no other reasonable method for completing the electrical work, and where the proposed cutting clearly does not materially weaken the structure.
- B. Cutting Concrete: Where authorized, cut openings through concrete (for conduit penetrations and similar services) by core drilling or sawing. Do not cut by hammer-driven chisel or drill.
- C. Other Work: Do not endanger or damage other work through the procedures and process of cutting to accommodate electrical work. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.
- D. Patching: Where patching is required to restore other work, because of cutting or other damage inflicted during the installation of electrical work, execute the patching in the manner recommended by the original Installer. Restore the other work in every respect, including the elimination of visual defects in exposed finished, as judged by the Design Professional. Engage the original Installer to complete patching of various categories of work including: concrete and masonry finishing, waterproofing and roofing, exposed wall finishes, etc.

3.4 INTERFACE OF ELECTRICAL WORK WITH OTHER TRADES:

- A. Where electrical work must connect to or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:
 - 1. Roof Penetrations.
 - 2. Any attachments to roofing system.

3. Penetrations in Vapor Barriers.
4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 260100

SECTION 260120 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

- A. Submit for review by the Design Professional a schedule with engineering data of materials and equipment to be incorporated in the work.
 - 1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
 - 2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete electrical characteristics shall be provided for all equipment.
 - 3. Submittals for lighting fixtures shall include Photometric Data.
 - 4. The Design Professional reserves the rights to require samples of any equipment to be submitted for review.
- B. Prepare submittals, including the necessary inter-division planning and coordination in accordance with the approved project schedule. Note that certain Division 26 submittals cannot be prepared until approved submittals are available from other Divisions of the work.
- C. Submittal material shall be assembled and checked by the Division 26 superintendent.
- D. All layout drawings shall be prepared under the supervision of, and checked by the Division 26 superintendent.
- E. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 26 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.
- F. Electronic Submittals: All electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 26 Superintendent's name, Suppliers and point of contact for each, and date.

- G. The fault current calculation required by Section 262042-Panelboards, 262044-Separately Enclosed Circuit Breakers shall be provided after service has been installed and inspected by the Authority Having Jurisdiction.

1.3 RESPONSE TO SUBMITTALS:

- A. The contractor shall review all submittals prior to submitting to ensure compliance with the contract documents. Comments made by the Design Professional do not relieve the contractor from complying with the contract documents (drawings, specifications, and addenda). The Design Professional does not approve any submittals. The Design Professional only reviews and makes observations regarding the submittals.
- B. The purpose of the submittals is to demonstrate to the Design Professional that the contractor understands the design concept and that he demonstrates his understanding by indicating which equipment and materials he intends to furnish and install. Any deviation from the contract documents shall be clearly stated on the submittal data. If not clearly stated, the submittal shall be marked "Revise and Resubmit". Failure of the contractor to provide submittals during the submittal process shall make the contractor totally responsible for any and all changes to achieve compliance with the contract documents.
- C. Shop drawings shall be evaluated by the Design Professional in accordance with the following classifications:
 - 1. **"No Exceptions Taken"**: No corrections, no marks. Items may be ordered.
 - 2. **"Make Corrections Noted"**: A few minor corrections. Items may be ordered as marked up without further resubmission.
 - 3. **"Revise and Resubmit"**: Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
 - 4. **"Rejected"**: Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.
- D. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 26 0100.

1.4 SUBMITTAL GROUPING:

- A. Submittals shall be made in no more than 2 groups.
- B. All submittals for a given system shall be submitted at the same time. For example, wiring diagrams and other detailed layout information must be submitted with equipment data sheets.
- C. Submittals that do not comply with these requirements or that are deemed by the Design Professional to be incorrect shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.5 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

- A. Section 260100 - General Provisions
 - 1. Superintendent's resume
 - 2. Electricians' qualifications
 - 3. Supervisor's resume - Primary cable installation
 - 4. Installer's resume - Primary cable terminations and splices
 - 5. Letter from company furnishing the Lightning Protection System stating that they comply with the requirements set forth in Section 265000.
 - 6. Test Schedules.

- B. Section 260120 - Electrical Submittals
 - 1. Equipment Layout Drawings
 - 2. Attachment 1

- C. Section 261010 - Raceway Systems
 - 1. Raceways and Fittings
 - 2. Expansion Fittings
 - 3. Wall Boxes and Covers
 - 4. Ceiling Boxes and Covers
 - 5. Floor Boxes and plates
 - 6. Pull Boxes
 - 7. Troughs
 - 8. Firestopping Materials and Installation Drawings
 - 9. Corrosion Protection

- D. Section 261011 - Underground Ducts and Duct Banks
 - 1. Conduits
 - 2. Fittings
 - 3. Profile drawings

- E. Section 262010 - Wires and Cables
 - 1. Conductors
 - 2. Connectors
 - 3. Splices

- F. Section 262020 - Wiring Devices
 - 1. Receptacles
 - 2. GFCI Receptacles
 - 3. Weather Resistant Rated GFCI Receptacles
 - 4. Switches
 - 5. Dimmers
 - 6. Occupancy/Vacancy Sensors & switches
 - 7. Occupancy/Vacancy Sensor layout drawings
 - 8. Photo-sensors
 - 9. Daylight Harvesting layout drawings
 - 10. Tele-Power Poles
 - 11. Weatherproof Covers
 - 12. Device Plates
 - 13. Temporary Protective Covers

- G. Section 262021 - Safety and Disconnect Switches
 - 1. Safety Switches

2. Fuses (Including Current-Limitation Charts)
 3. Motor Rated Switches
 4. Equipment List
 5. Arc Flash Warning Labels
 6. Nameplates
- H. Section 262030 - Lighting Fixtures
1. Lighting Fixtures
 2. Ballasts
 3. Lamps
 4. Emergency Ballasts
 5. Flexible Wiring System Receptacles
 6. Color Samples
- I. Section 262031 – Lighting Control Systems
1. Dimming panel.
 2. Control units.
 3. Load schedule.
 4. Confirmation that lamps and ballasts are compatible with system.
 5. System specific drawings, including scene definition.
 6. Nameplates
- J. Section 262042 - Panelboards
1. Enclosures
 2. Dimensional Data
 3. Locks
 4. Directory
 5. Circuit Breakers
 6. Bussing Diagrams
 7. Metering
 8. Arc Flash Warning Labels
 9. Nameplates
- K. Section 262044 - Separately Enclosed Circuit Breakers
1. Circuit Breakers
 2. Enclosures
 3. Dimensional Data
 4. Control Wiring Diagrams
 5. Arc Flash Warning Labels
 6. Nameplates
- L. Section 262047 - Dry Type Transformers, 600V and Below
1. Enclosures
 2. Dimensional Data
 3. % Impedance
 4. Temperature Rating
 5. Winding Material
 6. Taps
 7. Sound Ratings
 8. Efficiency Ratings at 25%, 50%, 75% and 100% load.
 9. Wiring Diagram (including grounding and bonding)

10. Vibration Dampening Mounts
 11. Arc Flash Warning Labels
 12. Nameplates
- M. Section 262049 - Surge Suppression / EHF Filter System
1. Data sheets
 2. Dimensions for each suppressor type indicating mounting arrangement and required accessory hardware. Statement that maximum lead length required to connect suppressor will not increase clamping voltages from published values.
 3. Manufacturer's letter certifying compliance with listed guidelines and standards.
- N. Section 262080 - Electrical Grounding, 600V and Below
1. Ground Rods
 2. Conductors
 3. Connectors
 4. Bonding Bushings
 5. Ground Rod Enclosures
- O. Section 264000 – Seismic Control for Electrical Equipment
1. Seismic anchorage requirements and calculations (with Registered Engineer's stamp.)
 2. Seismic control devices.
- P. Section 265000 - Lightning Protection System
1. Lightning Protection System Components
 2. Layout drawing including all bonding of metal bodies
 3. Installation Details
 4. Letter from Roofing Contractor / Roof Supports and Penetrations
 5. Installer Qualifications
 6. Certification that system complies with U.L. Masterlabel requirements

PART 2 – PRODUCTS

2.1 NOT APPLICABLE:

PART 3 - EXECUTION

3.1 MANUFACTURER'S DATA:

- A. Include the manufacturer's comprehensive product data sheet and installation instructions.
- B. Where operating ranges are shown, mark data to show portion of range required for project application.
- C. Where pre-printed data sheet covers more than one distinct product-size, type, material, trim, accessory group, or other variations, delete or mark-out portions of the pre-printed data which are not applicable.

3.2 EQUIPMENT LIST:

- A. Where more than one type of a product is being used (i.e., starters, disconnects, breakers, etc.) provide a list with each submittal correlating the type and size of product to the load served.

3.3 TEST REPORTS:

- A. Submit test reports which have been signed and dated by the firm performing the tests and prepare in the manner specified in the standard or regulation governing the tests procedure as indicated.

3.4 ELECTRICAL LAYOUT AND COORDINATION DRAWINGS:

- A. Electrical Rooms: Provide layouts of all electrical rooms, using the dimensions of equipment actually furnished. Locate all ducts and piping entering or crossing these spaces.
- B. Mechanical Rooms and Mechanical Equipment Yards: Provide layouts showing all mechanical equipment based on dimensions of the actual equipment provided. Show the location of all motor controls, disconnect switches, control power junction boxes and conduit stub-ups at equipment. Location of stub-ups shall be based on manufacturer's installation drawings.
- C. Panel and Equipment Feeders, 60A or more: The routing of feeders is not shown on the drawings. Actual routing shall be determined by the contractor in accordance with the specifications and shall be coordinated with work by other trades. For feeders of 60A or higher rating, provide layout drawings showing proposed routes.
- D. Duct Bank Profiles: Provide profiles for the entire length of all duct banks as specified in Section 261011.
- E. Composite site utility coordination drawing: A composite drawing will be prepared by the Division 2 contractor. The composite drawing will show all underground lines and structures within the project boundaries. The Division 26 superintendent shall participate in all planning required to produce this document.
- F. Provide dimensioned layout drawings for all pendant mounted lighting fixtures as specified in Section 262030.
- G. Provide dimensioned installation drawing for each busway system. All components shall be identified.
- H. Lightning protection system layout drawings, as specified in Section 265000.
- I. System specific drawings - Include the following:
 - 1. Floor plans:
 - a. Show all system equipment, devices, and interconnecting cabling. Provide a legend

- to define all devices and cable runs.
2. Details:
 - a. Show the rough-in requirements and mounting height for every component Include all requirements such as outlet box size/trim/alignment and raceway requirements.
 - b. Prepare in sufficient detail such that these drawings can be used to provide the required rough-in.
 3. Point-to-point installation wiring diagrams of the entire system:
 - a. Provide terminal diagram for every control panel.
 - b. Provide wiring diagram for every device. Key these diagrams to the system diagrams.
 - c. Provide wiring diagram depicting all interlocks of specific systems with other systems.
 - d. Spare and unused terminals shall be marked as such. Indicate the size, type and color code of all conductors.
 - e. The use of generic wiring diagrams is not acceptable. Wiring diagrams shall be prepared for this specific project.
 4. Elevations:
 - a. Provide an elevation drawing of the headend equipment / control panel / backboard, showing the location of all components.
 - b. Indicate enclosure sizes and space available for future expansion.
- J. Drawing Format:
1. Drawings shall be prepared at the following scales:
 - a. Floor plans: 1/8" = 1'-0".
 - b. Electrical Rooms: 1/4" = 1'-0".
 - c. Mechanical Rooms / Equipment Yards: 1/4" = 1'-0".
 - d. Feeder routes: 1/16 " = 1'-0".
 - e. Duct Bank Profile Drawings: See Section 261011.
 - f. Layout drawings for pendant mounted lighting fixtures: 1/2" = 1'-0".
 - g. Lightning protection system layout drawings: 1/16 " = 1' - 0".
 2. The scales defined above are for plan views. Device assembly drawings, wiring diagrams, etc. may be prepared “not to scale”.
 3. Drawings shall be titled to define Project Name, Drawing subject, date prepared and designer’s name and seal. All revisions shall be marked and dated.
 4. Drawings shall include all room names and numbers.
 5. CAD-generated drawings are required. Upon written request, a .zip file containing the building floor plan(s) can be furnished to the contractor at a nominal cost, in AutoCAD 2020 format. By requesting these drawings, the contractor agrees to accept them “as is”. It will be the responsibility of the contractor to verify the drawings for accuracy and to make all changes necessary, at no additional cost to the Owner.
 6. Submit only one copy of each drawing, in reproducible format. The Design Professional will mark review comments on the reproducible drawing so that the contractor can make as many copies as may be required.

3.5 ATTACHMENT NO. 1:

- A. The intent of Attachment Number 1 is to ensure that the electrical requirements for equipment have been reviewed and coordinated by the Contractor. No electrical equipment shall be ordered, nor shall rough-in begin, before this coordination has taken place. This document shall be returned appropriately marked whether or not any changes are deemed to be necessary by the contractor.

ATTACHMENT NO. 1

SHOP DRAWING COORDINATION AFFIDAVIT

I, the Division 26 Superintendent, certify that I have reviewed the equipment shop drawings for electrically driven equipment and that the accompanying electrical shop drawings reflect the requirements of the actual equipment to be furnished for use on this project. The following deviations from design drawings were required to serve the furnished equipment:

ITEM	CKT. DESIG.	BKR.SIZE		CONDUIT/WIRE		DISC.SIZE		STARTER	
		New	Old	New	Old	New	Old	New	Old

NOTE: If no deviations are required please indicate by circling the appropriate answer above your signature.

PROJECT: _____ DEVIATIONS: Yes / No

COMPANY: _____

TITLE: _____ SIGNATURE: _____

TELEPHONE: _____ DATE: _____

FAILURE TO PERFORM THE WORK REQUIRED BY THIS AFFIDAVIT, PRIOR TO ORDERING MATERIALS OR ROUGHING-IN, MAY RESULT IN IMPROPER CONNECTIONS BEING PROVIDED. THE EXPENSE OF CORRECTIVE MEASURES, IF REQUIRED, SHALL BE BORNE BY THE CONTRACTOR.

END OF SECTION 260120

SECTION 260130 - ELECTRICAL EXCAVATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 QUALITY ASSURANCE:

- A. Coordination: Where excavation and backfill for electrical work passes through or occurs in the same areas as work specified in the Division 02 sections, comply with both the requirements of the Division 02 sections and the requirements of this section, whichever is the more stringent (as determined by the Design Professional in cases of conflicting requirements).

1.3 JOB CONDITIONS:

- A. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS:

- A. Subbase Material: A graded mixture of gravel, sand, crushed stone, or crushed slag.

PART 3 - EXECUTION

3.1 EXCAVATING:

- A. Inspection: The excavator must examine the areas to be excavated, and the conditions under which the work is to be performed and notify the Contractor in writing of conditions detrimental to the proper completion of the work. Do not proceed with excavating until unsatisfactory conditions have been corrected in a manner acceptable to the excavator.
- B. General:
 - 1. Do not excavate for electrical work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
 - 2. Provide signs, illuminations, and barricades as necessary to prevent accidents at excavations.

3. Excavate with vertical sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
4. Excavate for piping with 6" to 9" clearance both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves, and other work. Excavate for other electrical work to provide minimum practical but adequate working clearances. Provide a minimum of 12" clearance around underground tanks.
5. For work to be supported directly on undisturbed soil, do not excavate beyond required depths, and hand excavate the bottom cut to accurate elevations. Except as otherwise indicated, support the following work on undisturbed soil at the bottom of the excavations:
 - a. Piping of 5" and less pipe/tube size.
 - b. Cast-in-place concrete.
6. Where directed, excavate additional depth to reach satisfactory soil-bearing conditions. Backfill with subbase material, compacted as directed, to indicated excavation depth.
7. Except as otherwise indicated, excavate for exterior water-bearing piping so that the top of piping will not be less than 2'- 0" vertical distance below finished grade.
8. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work.
 - a. Retain excavated material which complies with the requirements for backfill material.
 - b. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirement for backfill material.

3.2 DEWATERING:

- A. Maintain dry excavations for electrical work by removing water. Pump minor inflow of ground water from excavations; protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing. Provide adequate barriers which will protect other excavations from being damaged by water, sediment, or erosion from or through electrical work excavations.

3.3 BASE PREPARATION:

- A. Install subbase material to receive electrical work and compact by tamping to form a firm base for the work. For piping, shape the subbase to fit the shape of the bottom 90 degrees of the cylinder, for uniform continuous support.
- B. Shape subbases and bottoms of excavations with recesses to receive pipe bells, flanges connections, valves, and similar enlargements in the piping systems.

3.4 BACKFILLING:

- A. Do not backfill until installed electrical work has been tested and accepted, wherever testing is indicated.

- B. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.
- C. Backfill simultaneously on opposite sides of electrical work and compact simultaneously; do not dislocate the work from installed positions.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
 - 1. Lawn/Landscaped Areas: 90%
 - 2. Roadways: 95%
 - 3. Paved Area, Other than Roadways: 95%
- E. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for electrical work.
- F. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Design Professional.

3.5 PERFORMANCE AND MAINTENANCE:

- A. Where subsidence is measurable or observable at electrical work excavations during the guarantee period, remove the surface (pavement, lawn, or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work and eliminate evidence of the restoration to the greatest extent possible.

END OF SECTION 260130

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. The systems addressed by Division 26 that will be commissioned on this project are as follows:
 - 1. Electrical Systems. The following electrical systems shall be commissioned:
 - a. Lighting controls (scheduled activators and occupancy sensors, etc)
 - b. Service Switchgear
 - c. Emergency power system
 - d. Generators / auto transfer switches
 - e. Lighting – exterior
 - f. Distribution panel boards
 - g. Transient voltage surge suppressors
 - h. Grounding and ground fault systems
 - i. Over-current protective devices
 - j. Fire alarm and smoke detectors
 - k. Standby and emergency power systems
 - l. Emergency Lighting
 - m. Transformers
 - n. Power monitoring and metering
- C. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 9100 – COMMISSIONING OF MEP SYSTEMS. A Commissioning Authority (CxA) has been appointed by the Owner to manage the commissioning process.

1.2 RELATED SECTIONS

- A. Section 01 9100 – COMMISSIONING OF MEP SYSTEMS.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 019100.
- B. Refer to Section 019100 – COMMISSIONING OF MEP SYSTEMS for more details regarding processes and procedures as well as roles and responsibilities of the contractor and CxA.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's

Operation and Maintenance personnel in accordance with the requirements of Section 019100 and of Division 26, is required in cooperation with the CxA.

- B. The Facility electrical systems commissioning will include the systems listed in 019100 – COMMISSIONING OF MEP SYSTEMS and repeated in section 1.1.B above.

1.6 SUBMITTALS

- A. The commissioning process requires Submittal review simultaneously with engineering review. The contractor shall distribute copies of submittals to the CxA in accordance with the requirements of Section 019100 – COMMISSIONING OF MEP SYSTEMS.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the CxA in accordance with Section 019100 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 VERIFICATION CHECKLISTS

- A. The Contractor shall complete Verification Checklists to verify that systems, subsystems, and equipment installation is complete, and systems are ready for Systems Functional Performance Testing. The CxA will prepare Verification Checklists to document equipment installation. The Contractor shall complete the checklists and forward to CxA for review within two days of completion of the checklist. The CxA may verify a sample of completed checklists. If the CxA determines that the information provided on the checklist is not accurate, the CxA will return the marked-up checklist to the Contractor for correction and resubmission. If the CxA determines that a significant number of completed checklists for similar equipment are not accurate, the CxA will select a broader sample of checklists for review. If the CxA determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 019100 – COMMISSIONING OF MEP SYSTEMS for submittal requirements for Verification Checklists, Startup Procedures, and other commissioning documents.

3.3 PRE-FUNCTIONAL TESTING

- A. System Startup Testing and other testing as required by the other sections of Division 26 shall be scheduled and documented in accordance with Section 019100 – COMMISSIONING OF MEP SYSTEMS. All testing shall be incorporated into the project schedule. Contractor shall provide notice of planned testing to the CxA no less than seven days in advance of testing. The CxA will witness all, or a portion of the testing as described in Section 019100. All pre-functional testing,

to include applicable startup testing, shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes system Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The CxA will prepare detailed Functional Performance Test procedures for review and approval by the Design Professional. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The CxA will witness the testing. The Contractor shall ensure data is recorded as required in the applicable procedure and sign the test reports. See Section 019100 – COMMISSIONING OF MEP SYSTEMS, for additional details.

3.5 TRAINING OF PERSONNEL

- A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the CxA as described in Section 019100 – COMMISSIONING OF MEP SYSTEMS. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas, trainer credentials, and other information as required in Section 019100. Refer to Section 019100 – COMMISSIONING OF MEP SYSTEMS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION 26 0800

SECTION 261010 - RACEWAY SYSTEMS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. The requirements of this section apply to all electrical raceway systems and supporting devices, installed under this contract, except for concrete encased duct banks. Electrical raceway system is defined to include, but not be limited to, all electrical raceways, boxes, fittings, and similar components necessary for a continuous pathway for the installation of cables or conductors. Supports are any devices or components used to support raceways or electrical equipment.
- B. Concrete encased duct banks are specified under Section 261011.
- C. Cable Trays for low voltage systems are specified in Section 261020.

1.3 QUALITY ASSURANCE:

- A. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL METALLIC TUBING (EMT):

- A. Uses permitted:
 - 1. Indoors concealed in walls or ceiling.
 - 2. Concealed in slabs above grade.
 - 3. Exposed horizontal runs installed at least 7' above finished floor.

2.2 INTERMEDIATE METAL CONDUIT (IMC) OR RIGID GALVANIZED STEEL CONDUIT (RGS):

- A. Uses permitted:
 - 1. Indoors concealed or exposed.
 - 2. Transition from below grade nonmetallic raceway system to above grade metallic raceway system.
 - 3. Refrigerated spaces.
 - 4. Vertical drops serving equipment.

2.3 RIGID NON-METALLIC CONDUIT (SCHEDULE 40 PVC):

A. Uses permitted:

1. Below grade installations.
2. Grounding electrode conductor raceway.
3. Lightning protection system down conductor raceway.

2.4 FLEXIBLE METAL CONDUIT:

A. Uses permitted:

1. Final connection to lighting fixtures.
2. Final connection to other than Division 23 equipment located in indoor, dry locations.

2.5 LIQUID-TIGHT FLEXIBLE METAL CONDUIT:

A. Uses permitted:

1. Final connection to equipment in indoor or outdoor locations.

2.6 CABLE RUNWAY:

A. Installed where shown to support cables specified under Division 27, limited to use at backboards and above equipment cabinets. This product is not the same as the Cable Trays specified in Section 261020.

B. Material: ASTM A36 steel bar:

1. Stringers: 3/8" x 2"
2. Rungs: 1/2" x 1" steel channel welded, @ 9" on centers
3. Runway width: 12"

C. Finish: Baked polyester powder coat, telephone gray.

D. Provide hanger kits, corner kits and other accessory fittings needed to install in the configurations specified.

E. Cable runways and accessories shall be the product of *B-Line*, *Kindorf* or *Cope*.

2.7 INNERDUCTS:

A. Innerducts shall be used where specifically indicated.

B. Innerducts shall be solid wall (ribbed) suitable for the use intended.

C. Provide metered tape and pull cord in all innerducts.

D. When installed within conduits, terminate conduit runs with non-metallic, corrosion-proof, water/air/gas tight triplex or quadruplex duct plugs, for the number of innerducts installed.

Additionally, provide duct plugs of the same type in all runs in which conductors are not installed.

2.8 SLEEVES:

- A. Conduit sleeves shall be RGS unless otherwise required by the through penetration firestop system selected.
- B. Sleeves shall be minimum 1" and maximum 4" diameter, provided in quantities necessary to install cable systems specified in Divisions 23 and 27.
- C. The contractor shall take special note that sleeve fill will be limited by the specific through penetration firestop system used. ***In no case shall the fill exceed 40%.***

2.9 CONNECTORS/COUPLINGS:

- A. Connectors/couplings for use with EMT conduit shall be diecast compression type, except that steel, set screw type will be acceptable for EMT conduits sizes 2-1/2" and larger.
- B. Connectors/couplings for use with IMC and RGS conduit shall be threaded type.
- C. All connectors shall be insulated throat type.
- D. Locknuts shall be of the same material as connectors.
- E. All fittings shall be raintight. Fittings encased in concrete shall be concrete-tight.

2.10 CONDUIT BODIES:

- A. Provide galvanized steel or cast metal conduit bodies constructed with threaded conduit ends, removable cover, and corrosion resistant screws.

2.11 CEILING OUTLET BOXES:

- A. Provide 4" octagon, galvanized steel interior outlet boxes constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.
- B. Boxes used to support ceiling paddle fans shall be listed for the purpose.

2.12 WALL OUTLET BOXES:

- A. Recessed:
 - 1. Boxes shall be galvanized steel constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices.
 - 2. Minimum box size shall be 4" square by 1-1/2" deep.

3. Boxes for GFCI outlets, Division 22, Division 23, and Division 27 devices and other locations deemed necessary, shall be 4-11/16" square by 2 1/8" deep.
4. Boxes shall have square edge tile type covers.
5. Where devices are ganged, use gang-type boxes with gang box covers.
6. The use of gangable type outlet or switchboxes is not acceptable unless required by specific device manufacturer.
7. Use masonry type boxes of equal or greater volume to those specified above, in masonry walls.

B. Surface:

1. Use cast aluminum box with threaded hubs in conjunction with metallic conduit systems.

C. Special Conditions:

1. Where box type specified herein conflicts with requirements of equipment to be installed, equipment manufacturer's requirements shall govern.

2.13 FLOOR BOXES:

A. Recessed:

1. Recessed floor boxes shall comply with the details on the drawings and these specifications. Nominal dimensions shall be 10"x12"x6" deep.
2. Boxes shall be suitable for use in the floor in the floor for which it is being installed.
3. Interiors shall be compartmentalized, using metal barriers, to separate line and low voltage wiring. Barriers shall be configured to accept the number and type of devices shown on the drawings.
4. Boxes shall be provided with both a temporary and finished covers, nominal 10.5"x12.5". Temporary cover shall be 11-gauge cold-rolled steel. Finished cover shall be 1/8" thick cold-rolled steel with 6-1/2"x8" hinged cover and nominal 3"x3" hinged cable access door, both with 1/4" high aluminum edging.
5. Floor boxes shall have three duplex receptacles and mounting provisions for Division 27 telecommunications jacks as indicated on the drawings.
6. Provide blank metallic covers for all unused openings.
7. Provide hubs suitable for the wiring installed.

B. Poke-Thru:

1. Flush floor boxes shall be *Wiremold RC4 Series*, 4-gang, poke through type, or equivalent by *Hubbell*, *Walker*, or *Amp*. The poke-thru assembly shall contain a 3/4" conduit for power and two 1/2" conduits or (1) 1" conduit for data.
2. Floor boxes shall have two duplex receptacles and mounting provisions for telecommunications jacks as indicated on the drawings.
3. Boxes shall be compartmentalized to separate line and low voltage wiring, by the use of metal barriers.
4. Provide mounting hardware and device plates for all devices installed.
5. Devices shall be *UL* listed and classified for use in 1-hour rated concrete floors.

2.14 INTERIOR PULL BOXES:

- A. Provide galvanized sheet steel boxes without knockouts. Provide surface boxes with screw-held covers in unfinished areas. In finished areas, including storage rooms, provide recessed

boxes with screw-held cover, finished to match panelboards.

2.15 WIRING TROUGHS:

- A. Troughs shall be made of code gauge galvanized steel, without knockouts, and shall be suitable for surface mounting. Provide screw-held, removable front cover. Trough and cover shall be finished the same as panelboards. Dimensions shall be as indicated on the drawings. Provide knockouts as required.

2.16 SUPPORTS:

- A. Supporting devices shall be the products of manufacturers' specifically intended for supporting electrical raceways, devices, and equipment. Makeshift supports are not acceptable. Where channel type supports are used, select complete assemblies based on the weight of the raceway(s) or equipment being supported.
- B. The use of tie wire or tie wraps as a means of support for electrical raceways, devices and equipment is not permitted.
- C. Plywood backboards shown in Communications Rooms or otherwise for the support of low-voltage cabling systems and/or mounting of equipment shall be fire resistant, Type AC rated. The plywood shall be painted with gray, fire resistant coating. Ensure that the plywood rating seal is left exposed after painting.

2.17 FIRESTOPPING:

- A. A through-penetration firestop system shall be used to seal penetrations of electrical conduits and cables through fire-rated partitions per *NEC 300-21* and *NEC 800-3*. The firestop system shall be qualified by formal performance testing in accordance with *ASTM E-814*, or *UL 1479*.
- B. The firestop system shall consist of a fire-rated caulk type substance and a high temperature fiber insulation. It shall be permanently flexible, waterproof, non-toxic, smoke and gas tight and have a high adhesion to all solids so damming is not required. Only metal conduit shall be used in conjunction with this system to penetrate fire rated partitions. Install in strict compliance with manufacturer's recommendations. *3M, Metacaulk* or *Nelson*.
- C. **Submit installation drawings for conduit penetration, cable in metal sleeve penetration and blank metal sleeve penetration for each type of wall/floor construction encountered.**
- D. Schedule a representative of the manufacturer to conduct a product demonstration / training session for each through-penetration firestop system to be used on this project. The session shall be held at the project site. Submit a letter to the Design Professional stating when the demonstration will be conducted.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL:

- A. Wherever possible, install horizontal raceway runs above water and drain piping. Give the right-of-way in confined spaces to piping which must slope for drainage and to larger HVAC duct work and similar services which are less conformable than electrical services. *However, ensure that all junction boxes and other points of access in raceway systems are located such that they are not rendered inaccessible.*
- B. Complete the installation of electrical raceways before starting installation of cables within raceways.
- C. All above grade conduits shall be routed parallel or perpendicular to the building structure.
- D. **Raceways shall not be installed exposed in finished spaces or on the exterior of the building.** Install concealed in walls, ceilings, below slab-on-grade or embedded in slabs above grade. *Where raceway system serves surface mounted equipment (i.e., safety switch), mount equipment over recessed outlet box.*
- E. All exposed raceway systems shall be painted to match the surface to which it is attached. All components of the raceway system shall be painted, i.e., conduits, boxes, supports, etc. Painting is specified under other divisions of the work.
- F. Provide 200 lb. nylon pull cord in all conduits installed for cable systems specified under Division 23 and Division 27; and where conduits will be left empty for future use. Cap open ends and mark location of opposite end with black indelible marker pen.
- G. Seal the inside of all conduits entering the building from outside, whether they connect to enclosures or not.
- H. Do not run raceways atop the roof deck, through stairwells or elevator shafts.

3.2 BELOW SLAB AND IN-SLAB INSTALLATIONS: (within the building footprint)

- A. *Do not install conduits in slabs on-grade.* Raceways shall be routed under the first floor building slab. Conduits shall be routed such that the top of the conduit is a minimum of 6" below the slab.
- B. All 90-degree elbows and all stub-ups through the floor slab for all size conduits shall be corrosion protected RGS or corrosion protected IMC. *Exception: Branch circuit conduits containing conductors No 10 AWG and smaller, which turn up inside walls to an outlet box, may use schedule 40 PVC elbow and stub up.*
- C. Raceways in slabs above grade shall be totally embedded in the slab. They shall be placed above the lower reinforcing and below the upper reinforcing. The outer edge in no case shall be less than 1" from the surface of the slab. The corners of raceways at turnups into walls shall not be exposed at the wall/floor junction.
- D. Raceways for Division 27 systems shall not be installed in or below slabs unless specifically indicated.

3.3 BELOW GRADE INSTALLATIONS: (Outside the Building Footprint)

- A. Perform all excavating, trenching, and backfilling to install work of this project in accordance with applicable sections of Division 02 of the specifications and *ANSI C2*. Bottom of trenches shall be smooth and level to provide uniform bearing for conduits.
- B. Secure conduits in trench to eliminate unnecessary curvature and to prevent movement of conduits while backfilling.
- C. Maintain 6" vertical separation between conduits installed one above the other. Backfill and compact each layer separately. The minimum cover requirements specified herein shall be referenced to the uppermost layer of conduits.
- D. Maintain minimum 12" horizontal and 6" vertical separation between conduits of different systems and between other underground utilities.
- E. Do not backfill until installed electrical work has been tested and accepted, wherever testing is indicated.
- F. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen soil materials.
- G. Backfill simultaneously on opposite sides of electrical work and compact simultaneously; do not dislocate the work from installed positions.
- H. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM Standard Proctor), using power-driven hand-operated compaction equipment.
 - 1. Lawn/Landscaped Areas: 90%
 - 2. Roadways: 95%
 - 3. Paved Area, Other than Roadways: 95%
- I. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
- J. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary) and provide additional testing as directed by the Design Professional.
- K. Minimum cover requirements:
 - 1. Exterior lighting branch circuits: 18".
 - 2. Telephone / TV service conduits: 24".
 - 3. Service entrance and feeder conduits, 600V and below: 24".
- L. Secondary service entrance conduits:
 - 1. Install conduits using base, intermediate and top spacers specifically intended for non-concrete encasement. Install spacers every 5'.
 - 2. Backfill to top of conduits with river sand to ensure that compaction around spacers is

achieved.

3.4 GRADE LEVEL PULL BOXES:

- A. Top of boxes shall be set flush with finished grade and shall be aligned parallel or perpendicular to predominant site features (i.e., sidewalks, etc.)
- B. The exact location of boxes shall be field determined based on existing conditions and coordination with other underground utilities.
- C. Conduits shall enter boxes through field-made openings in the sides of box. Conduits shall not enter the bottom of box. Make and seal all openings in accordance with the box manufacturer's recommendations.
- D. Provide a 6" layer of crushed rocks beneath open-bottom type boxes.

3.5 MOISTURE PROTECTION:

- A. Conduits entering refrigerated spaces - Provide sealing fitting at accessible location outside the refrigerated space. Seal raceway to prevent the entry of moisture.
- B. Where conduits pass from a conditioned space to a non-conditioned space, apply insulating electrical putty inside conduit, at an accessible location, to prevent the entry of moisture.
- C. Conduits and boxes installed in exterior walls shall not penetrate the vapor barrier.
- D. Boxes installed on the building exterior shall have gasketed covers. All conduits entering box shall be sealed with insulating electrical putty.

3.6 CORROSION PROTECTION:

- A. Corrosion protection for conduits passing through concrete slabs shall be by one of the following means:
 - 1. Field-wrap conduits with tape, using with a 50% overlay. Tape shall be premium 7-mil, flame retardant, weather resistant tape. Resists temperature and moisture for splicing. Meets requirements of *UL 510*, *HHI-595*, and *CSA 22.2*.
 - 2. Conduits shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating.
- B. All supporting materials installed exposed on the building exterior shall be hot-dipped galvanized after fabrication or provide an equivalent level of corrosion protection. Protect exterior raceway systems from damage while the building exterior is cleaned. Replace any portions of the system showing signs of rust at the time of final inspection.

3.7 GROUNDING:

- A. Metallic raceway systems shall be made electrically continuous to provide a low impedance path to ground for faults, as required by the *NEC*.

3.8 RACEWAY BENDS:

- A. Bend radius shall comply with the *NEC* and the requirements of the specific cabling system installed. For television and telephone service entrance conduits, consult with the local utility.
- B. All field bends shall be made with a tool specifically intended for the purpose.
- C. Tools using open flames are not acceptable for bending PVC conduit. Any section of conduit discolored or deformed in any way shall be cut out and replaced.

3.9 FLEXIBLE CONNECTIONS:

- A. Final connections to light fixtures may be made using 3/8" diameter flexible metal conduit not exceeding 6' in length.
- B. 1/2" diameter flexible metallic conduit may be used to fish existing walls, within the limits of *NFPA 70*.
- C. Final connections to motors and to other electrical equipment subject to movement and vibration shall be made using liquid-tight flexible metal conduit not more than 24" long.

3.10 SLEEVES:

- A. Provide sleeves of the size and quantity required to install cabling systems specified under Division 23 and Division 27. Where multiple sleeves are required, install in a rectangular array.
- B. Make and seal all penetrations to maintain fire rating of member penetrated. Pay particular attention to the annular space required around the inside and outside of the penetrating item. Sealing compounds shall be re-enterable type.
- C. Coordinate the exact placement of sleeves with other trades to ensure they are readily accessible and are not obstructed by pipes, ductwork, etc.
- D. Sleeves shall be flush with both sides of the member penetrated unless otherwise required by the through penetration firestop system selected.

3.11 RACEWAY LAYOUT:

- A. Unless noted otherwise, the layout of all raceway systems is the responsibility of the Contractor.
- B. Provide pull points as required by the *NEC* and ensure that all such points are readily accessible and not blocked by ducts, pipes, etc.

3.12 WALL OUTLET LAYOUT:

- A. The location of devices shown on the drawings is schematic. Prior to roughing-in, review the architectural interior elevations and millwork shop drawings, to ensure that outlets will not be installed behind cabinets or otherwise inaccessible. Ensure that there is sufficient space from door jamb, cabinets, etc. to install without trimming device cover.
- B. Outlets installed below countertops shall be centered in the knee space.
- C. All outlets shall be installed vertically except where space above counter back splash and other features does not permit, and when installed in baseboards. In such cases, outlets shall be installed horizontally.
- D. Maintain uniform spacing of outlets shown to be side-by-side on the plans. Spacing shall not exceed 2" in framed walls. For masonry walls, install outlets in adjacent cells.
- E. Gang mount switches shown in the same location, unless noted otherwise. Provide metal barrier in boxes between switches, when switches are connected to opposite phases of systems exceeding 150V to ground.
- F. Mark the branch circuit identification on the cover of all outlet boxes.
- G. Provide separate outlet boxes and flexible final connections for fixtures provided with both normal and emergency power connections.

3.13 SUPPORTS:

- A. Raceways:
 - 1. Support all components of the electrical raceway system using wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work.
 - 2. Support individual raceways with conduit straps or clips. Support multiple runs using trapeze-type hangers. Trapeze hangers shall consist of 1-1/2"x1-1/2" gage steel channels, 1/2" diameter threaded steel rods and conduit clamps. Attach rods to the building structure or to 1-1/2" x 1-1/2" gage steel channels span between adjacent structural members.
 - 3. Support conduits at distances required by the *National Electrical Code*. *Additional supports shall be provided at the points of tangency of all bends.*
 - 4. Joints in conduit systems shall coincide with point of support.
 - 5. Provide expansion joints in all raceway systems in either of the following conditions:
 - a. In accordance with manufacturer's literature, based on length of run and temperature differential that will be encountered.
 - b. When raceways cross expansion joints.
- B. Outlet Boxes:
 - 1. Ceiling outlet boxes shall be supported by lightweight channel attached to structure with (2) 1/4" threaded rods and braced to prevent lateral movement. Boxes used to support ceiling paddle fans shall be listed for the purpose.
 - 2. Masonry walls:

- a. Install outlet boxes in sawcut openings.
- b. Outlet boxes shall be grouted in place, back and sides. There shall no reveals around the perimeter of the box.
3. Framed walls:
 - a. Non-rated walls - Outlet boxes shall be attached to intermediate horizontal supports between vertical framing members. *Do not attach boxes to vertical members.*
 - b. Framed walls rated 1-hr or 2-hr, boxes 16 square inches or less - Compartmentalize each outlet box (top, bottom, and sides) using same material as wall framing. All penetrations in framing members shall be sealed. Where penetrations exceed 100 square inches per 100 square feet of wall space, install in accordance with subparagraph "c" below.
 - c. Framed walls rated 1-hr or 2-hr, boxes exceeding 16 square inches - Compartmentalize boxes as specified above. Additionally, Boxes shall be covered back, top, bottom and all sides with drywall such that the rating is carried around the box. All penetrations in this envelope shall be sealed.
4. Boxes shall not be installed in walls rated more than 2-hour.
5. Do not install outlets back-to-back. Maintain 24" offset in rated walls and with no overlap in non-rated walls. Where groups of outlets are shown back-to-back, each group of outlets shall be shifted to accommodate the installation. *Exceptions: (1- Outlet boxes in non-rated masonry walls, may be installed back-to-back. Do not break webbing or connect boxes back-to-back. The use of thru-wall outlet boxes is not permitted. 2- The 24" offset may be eliminated in 1-hour and 2-hour walls when UL listed moldable putty is installed around box, in accordance with the UL Fire Resistance Directory.)*
6. Outlet boxes mounted in STC rated walls shall be sealed in accordance with *Gypsum Association Document GA-600 Fire Resistance Design Manual, Sound Control.*
7. Cover of outlets installed flush mounted in walls shall be set back no more than 1/8" from face of wall.

3.14 FLOOR BOXES:

A. General:

1. Floor box locations shall be by FSR or equal based on the dimensions shown on the drawings, subject to field co-ordination with building structural elements. Any necessary adjustments in location shall be approved by the Design Professional. The location process is critical to ensure that placement of box does not interfere with furniture or user.
2. Floor boxes and raceway system shall be thoroughly cleaned and dried before installing devices and wiring. Seal the inside of all raceways entering floor box with clear, re-entenable, water-proofing compound after conductors and cables have been installed.

B. Recessed:

1. Floor boxes shall be covered by concrete on all sides. Boxes shall be secured-in-place to keep boxes from moving during pouring of the building floor slab.
2. Set box in concrete such that the top of the box is even with the top of the unfinished slab.
3. Infill the removable lid with the same material as the floor covering.
4. Installations that are not level, flush with floor or aligned with furniture shall be removed and replaced.
5. Conduits shall enter openings provided in the sides of the box. Under no circumstances shall openings be field cut or shall conduits enter openings in the bottom of box.

6. Temporary covers shall remain in place until floor covering is installed. Temporary covers shall be delivered to the Using Agency upon completion of the work.

3.15 ROUGH-IN FOR DIVISION 27 SYSTEMS AND USING AGENCY PROVIDED TELECOMMUNICATIONS SYSTEMS:

- A. Provide all outlet and junction boxes, sleeves, and raceways to form an accessible pathway from each wall or floor mounted device, and ceiling mounted devices to the IDF or MDF or headend equipment location in which the cable terminates, as specified herein and as indicated on the drawings. Cable trays are specified in Section 261020.
- B. Conduit sizes shall conform to the following:
 1. Voice / Data / Video outlet: 1"
 2. Voice / Data outlet: 1"
 3. Video outlet: 1"
 4. Fire alarm outlet: 3/4"
 5. Other: 3/4"
- C. Raceways shall be labeled to the extent necessary to allow easy identification by the cable system installers.
- D. Outlet box mounting height, cover type, and alignment shall be governed by Division 27.
- E. Refer to Section 279010 for additional requirements. Pay particular attention to the requirement that the fire alarm system wiring shall be installed in a complete raceway system.

3.16 ROUGH-IN FOR DIVISION 23 CONTROL WIRING:

- A. Provide outlet box and 3/4" conduit stubbed up to above accessible ceiling from each wall mounted device. Rough-in details shall be similar to that shown for Division 27 devices. Cabling support system above accessible ceilings for division 23 control wiring shall be supplied and installed by Division 23 contractor. In areas with exposed ceilings, such as mechanical rooms, provide complete conduit pathway to the associated control equipment.

3.17 ROUGH-IN FOR DIVISION 22 PLUMBING FIXTURE SENSORS:

- A. Provide outlet boxes for sensors and transformers furnished with the plumbing fixtures. Provide 1/2" conduit from each sensor location to a point within 6" of transformer outlet box, and terminate with insulated throat bushing.
- B. Provide wiring as described in the mechanical equipment connection schedule.

3.18 SPECIAL PROVISIONS FOR DEVICES INSTALLED IN MILLWORK:

- A. The millwork shall be provided with openings to accommodate device outlet boxes.
- B. Serve all "islands" from concealed stub up.

1. Power wiring within millwork may be flexible metallic conduit.
 2. Low voltage cables for Division 27 systems are not required to be installed in raceway within the millwork as long as the cables are accessible.
- 3.19 ROUGH-IN AND CONNECTIONS FOR ELECTRONIC DOOR HARDWARE:
- A. Provide raceways and 120V power connections as indicated on the drawings.
- 3.20 FIRESTOPPING:
- A. Do not proceed with firestopping until the field demonstration has been conducted.
 - B. Seal all penetrations based on rating / element being penetrated. Penetrations in non-rated walls shall be rated 1-hour.

END OF SECTION 261010

SECTION 261011 - UNDERGROUND DUCTS AND DUCT BANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Install concrete encased duct banks for:
 - 1. All exterior conduit runs for underground primary lines.
 - 2. Conduits crossing roadways.
- B. Install direct burial duct banks (i.e. non-concrete-encased) for:
 - 1. Secondary service entrance conduits between pad mounted transformer and edge of building.
- C. All duct banks crossing roadways shall be reinforced.

1.3 RELATED WORK:

- A. Concrete shall comply with the applicable Sections of Division 3.
- B. Excavation, trenching and backfilling shall comply with Section 261010 and the applicable sections of Division 2.
- C. Direct burial installations shall comply with Section 261010.
- D. Exterior pull boxes are specified under section 261010.

1.4 QUALITY ASSURANCE:

- A. Submittals:
 - 1. Submit profile drawing of along entire length of all duct banks. Show all utility crossings. Choose horizontal and vertical scales to clearly represent the proposed installation.
 - 2. Refer to section 260120 for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Ducts shall be 4" diameter, type Schedule 40 PVC for encased burial.
- B. Fittings for raceways shall be designed specifically for use with the type of raceway installed. All couplings or other connections shall be made tight and sealed to exclude water and concrete.
- C. Top, intermediate and bottom spacers of plastic, or other approved non-organic material, shall be provided to maintain a separation between raceways of not less than that shown on drawings. Spacers shall be of the type specifically intended for encased installations.
- D. Concrete encasement shall have 3000 lb. 28-day strength, 3/4" maximum sized aggregate.
- E. Provide a metallic warning tape in the backfill above all underground cables, conduits and duct banks. The tape shall be 3 inches wide, shall be bright, fade-resistant yellow in color, and shall include an imprinted legend, "WARNING - BURIED HIGH VOLTAGE LINE", "WARNING - BURIED FIBER OPTIC LINE" or "WARNING - BURIED TELEPHONE LINE", as applicable.
- F. Steel reinforcing as detailed shall be provided in the concrete envelope.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Layout of duct banks is the responsibility of the Contractor. Coordinate layout with existing site conditions, the elevation of manhole openings and work by other trades. Duct lines shall be sloped to drain towards manholes and pull boxes, with a pitch of not less than 3 inches in 100 feet. For lines run between adjacent manholes or pull boxes, high point may occur in the middle of run.
- B. Excavation, Trenching and Backfilling: Provide as required to install duct banks in the manner indicated on the drawings and in accordance with Section 261010 and the applicable sections of Division 2 of the specifications.
- C. Provide barricades with warning lights, around all trenches. Barricades shall be orange mesh type supported by rods driven into the earth. Barricades shall remain in place at all times, not just at night. Maintain the integrity and appearance of the barricades until the trenches have been backfilled and compacted.
- D. Minimum Cover: All lines shall have a minimum cover of 30". Install at greater depths where required to avoid conflicts with other utilities or existing conditions and to achieve the slope specified herein.
- E. Clearance from Other Utilities: Do not install lines installed under this contract in the same trenches with other utilities. Maintain horizontal and vertical separation as required by ANSI C2.

3.2 INSTALLATION:

- A. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand and dirt, by means of suitable conduit plugs. As each section of a duct line is completed from manhole to manhole, a testing mandrel not less than 12 inches long with a diameter 1/4-inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the conduit, and having stiff bristles, shall be drawn through until the conduit is clear of all particles of earth, sand, and/or gravel; conduit plugs shall then be immediately installed.
- B. Install spacers every 5' along the duct run and at the midpoint and points of tangency of all bends. Anchor spacers to trench to ensure that the duct banks are held securely in place during concrete pours.
- C. Ducts shall be encased in concrete as shown on the drawings. Care shall be taken that no voids are left between ducts.
- D. Ducts crossing roadways and parking lots shall be reinforced as indicated on the drawings. Cutting and patching shall conform to the details shown on the Civil drawings. Engage the services of the paving and grading contractor to perform all cutting and patching.
- E. Install warning tape 12" below grade along the entire length of, and centered on duct banks.
- F. Bends: Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 48".
- G. Connections to Manholes: Connections shall be constructed to have a flared section adjacent to the manhole to provide shear strength. Underground structures shall be constructed to provide for keying the concrete envelope of the duct line into the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure. Conduits shall terminate in end-bells where duct lines enter manholes.
- H. Connections at Pad Mounted transformers: Terminate encasement at underside of concrete pad.

3.3 RECONDITIONING OF SURFACES:

- A. Ground covering and vegetation disturbed during installation, shall be restored to original elevation and condition.
- B. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Sod that is damaged shall be replaced by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, the restored surface shall be re-seeded with the same quantity and formula of seed as that use in the original seeding.

END OF SECTION 261011

SECTION 262010 - WIRES AND CABLES, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. The requirements of this section apply to the wire and cable work installed under this contract.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: Provide wires and cables from manufacturers who have been in business for a minimum of five years.
- B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.
- B. Color Coding:
 - 1. Color shall be **green** for grounding conductors and **green with yellow stripe** for isolated grounding conductors.
 - 2. The color of the circuit conductors shall be as follows:

120/208 volt, 3-phase	Phase A - Black
	Phase B -Red
	Phase C - Blue
	Neutrals – White (with stripes as specified below)
	(High leg - Orange)
 277/480 volt, 3-phase:	 Phase A - Brown
	Phase B - Orange
	Phase C - Yellow
	Neutrals – Gray (with stripes as specified below)

- C. All conductors shall be 600V copper, with 75 C, THWN/THHN insulation. Minimum size shall be No. 12 AWG. Conductors within 3" of fixture ballasts shall be rated 90 C. Sizes up to No. 10 AWG may be stranded; sizes No. 8 AWG and larger shall be concentric-lay-stranded. All control conductors shall be concentric-lay-stranded.
- D. Conductors used in flexible metal conduit and liquid-tight flexible metal conduit used for final connection to equipment shall be stranded.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL:

- A. No more than (3) phase conductors, each of opposite phases for a three-phase WYE system, shall be combined in a single raceway without written permission from the Design Professional.
- B. For each ungrounded conductor, provide a dedicated neutral conductor, with stripe color to match ungrounded conductor insulation color.
- C. For each electrical connection/termination, provide a complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other materials necessary to complete splices and terminations. Torque all connections according to installation instructions.
- D. Motor connections shall be made with compression connectors forming a bolted in-line or stub-type connection. Connections shall be insulated with *Raychem MCK* motor connection kit.
- E. Splicing of feeder conductors shall not be acceptable, unless specifically indicated on the drawing. Where splicing of feeder conductors is indicated, splices shall be made using *Raychem RVS* splice kit and compression type butt splice
- F. Numbers 10 and 12 AWG stranded conductors shall not be directly terminated to screw-type terminals. The use of *Stacon* type compression connectors is required.
- G. All conductors shall be installed in raceways.
- H. Make connections to wiring devices using "pigtails" within outlet boxes. *Direct connection (loop) to devices is not acceptable.*

3.2 SPECIAL PROVISIONS FOR ISOLATED GROUND RECEPTACLE WIRING:

- A. Provide a separate neutral for each branch circuit serving isolated ground receptacles.

3.3 DISTANCE LIMITATIONS FOR 20A BRANCH CIRCUITS:

- A. All 120-volt, 20-amp branch circuits exceeding 90' in length shall consist of No. 10 AWG circuit conductors. Increase conduit size accordingly.
- B. All 277-volt, 20-amp branch circuits exceeding 150' in length shall consist of No. 10 AWG circuit conductors. Increase conduit size accordingly.

END OF SECTION 262010

SECTION 262020 - WIRING DEVICES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. The requirements of this section apply to all wiring devices installed under this contract.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers:
 - 1. Provide devices by manufacturers listed for each item.
- B. Occupancy/Vacancy sensor catalog numbers and locations shown on plans and specifications are for representation purposes only. Exact models and mounting locations shall be provided by sensor manufacturer. System drawings including device layout, device type, and wiring details shall be submitted for review in shop drawing phase prior to ordering. **All sensors shall be dual technology.**
- C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide factory-fabricated wiring devices, in type, color and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection as determined by Installer to fulfill the wiring requirements, and complying with *NEC* and *NEMA* standards for wiring devices.
- B. Device colors shall be selected by the Design Professional on an area-by-area basis.

2.2 GENERAL USE RECEPTACLES:

- A. Standard (Heavy-Duty Specification Grade): *Hubbell 5362, Arrow Hart/Eaton 5362, or Pass & Seymour 5362.*
- B. Tamper Resistant (Heavy-Duty Specification Grade): *Hubbell 5362TR, Arrow Hart/Eaton TR5362, or Pass & Seymour TR5362.*

- C. Isolated Ground Receptacles (Heavy-Duty Specification Grade): *Hubbell CR5352-IG, Arrow Hart/Eaton IG5362, or Pass & Seymour IG5362.*
- D. Ground-Fault Receptacles (Heavy-Duty Auto Grounding): *Hubbell GF20LA, Arrow Hart/Eaton SGF20, or Pass & Seymour 2095S.*
- E. Receptacles shall be 2-pole, 3-wire, grounding type, rated 20A/125V.
- F. Provide weather resistant receptacles in all outdoor locations.

2.3 SPECIAL PURPOSE RECEPTACLES:

- A. Provide heavy-duty type of the *NEMA* configuration indicated on the drawings, as manufactured by *Hubbell, Arrow Hart, or Pass & Seymour.*

2.4 SWITCHES:

- A. Toggle (Industrial Extra Heavy-Duty Specification Grade): *Hubbell HBL1221, Arrow Hart AH1221, or Pass & Seymour PS20AC1.* Provide single-pole, three-way and four-way switches as indicated. Catalog numbers listed herein are for single pole units. Other configurations shall be from the same product family.
- B. Keyed: Key switches shall be rated same as toggle switches but shall have cylindrical locking mechanism. *Fork-type keys are not acceptable.* Provide [6] keys to the Owner at the time of final inspection.
- C. Switches installed adjacent to dimmers shall be of the same type and style as dimmer.
- D. Narrow-body switches for installation in door-jambs shall not be used.
- E. Switches shall have ground screw.

- 2.5 WALL-BOX DIMMERS: Dimmer ratings shall be at least 125% of circuit load. Derate ganged installations as recommended by the Manufacturer. Dimmers shall be [preset] [slide-to-off] type. Provide single or three-pole, as indicated.

2.6 LIGHTING DIGITAL ROOM CONTROLLERS:

1. Basis of Design Product: *WattStopper LMRC-210.* Other acceptable manufacturers include *Hubbell, Lithonia, and Greengate.*
2. Device shall have enough 0-10V dimming outputs as indicated on contract drawings for quantity of dimming zones of control.
3. Minimum Features Shall Include:
 - a. Single-phase, multi-voltage 120/277VAC operation.
 - b. Maximum 20A combined load per room controller.

- c. Class 2 dimming control signal 0-10VDC
- d. Class 2 output to digital lighting management (DLM) local network: 24VDC, up to 250mA across 4 RJ45 ports.
- e. DLM local network parameters: Category 5e cable and up to 48 communicating devices.
- f. UL listed.

2.7 WALL CONTROL STATIONS FOR USE WITH ROOM CONTROLLERS:

- A. Basis of Design Product: *WattStopper LMSW-104* 4-Button Wall Switch with dimming control. Other acceptable manufacturer's include *Hubbell*, *Lithonia*, and *Greengate*.
- B. Minimum Features Shall Include:
 - 1. On/Off and continuous dimming functionality.
 - 2. 4-Button arrangement shall be on/raise/lower/off.
 - 3. Connectivity with other digital lighting management control devices with free-topology Category 5e network cabling.
 - 4. Provide decorator style face plates in accordance with wiring device accessories specified in section 2.11.

2.8 OCCUPANCY/VACANCY SENSORS:

- A. Corner Mounted: Dual technology (Ultrasonic & Infrared), ceiling or wall bracket mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. *WattStopper DT-200* series, *Hubbell LODT* series, or equivalent by *Greengate* or *Sensor Switch*.
- B. Ceiling Mounted: Dual technology (Ultrasonic & Infrared), ceiling mounted. Select based on size of space. Provide power pack and mounting hardware; suitable for switching 120 and/or 277 volt loads. *WattStopper DT-300* series, *Hubbell OMNIDT* series, or equivalent by *Cooper* or *Sensor Switch*.
- C. Wall Mounted: Dual technology (Ultrasonic & Infrared), wall bracket mounted. Select based on size of space. Suitable for switching 120 and/or 277 volt loads. *WattStopper DW-100* series, *Hubbell LHMTSI* series, or equivalent by *Cooper* or *Sensor Switch*. Device shall be installed with the factory default manual-on mode.
- D. Dimming Wall Switch Occupancy Sensors: Dual Technology *WattStopper DW-311* series, or equivalent suitable for switching 120- or 277-volt loads. Available switching schemes on device shall be Manual-ON, Auto-ON to 50%, 75%, and 100%. Default setting is to Manual-ON. Owner may request Auto-On to 50% function to be set after installation. Contractor shall be responsible for making this change to the operational setting.
- E. The triggering of only one technology shall keep the fixtures on.
- F. Power packs for sensors shall be rated for control of fractional horsepower motor loads in conjunction with the respective lighting load. Low-voltage multi-conductor cable between sensors and power packs shall be plenum rated, 22 AWG. Power pack shall have field selectable auto-on or manual-on mode. Basis of design: *WattStopper BZ-150*, or equivalent.

Contractor shall set power pack function to manual-on for all spaces not defined as life safety egress by the Design Professional's Life Safety Plan.

- G. Provide low voltage momentary pushbutton switch(es) for manual control in configuration shown on plans. Multiple switching zones shall be grouped in the least number of multi-pushbutton switches possible.
- H. Provide auxiliary contacts in sensors where shown on the project drawings, or as otherwise required for the functionality specified in the particular building space.
- I. Daylight sensors shall be of the same manufacturer as lighting control power pack as to ensure compatibility. Daylight sensors intended for use with digital room management systems shall be fully compatible with other digital room management lighting control components (i.e., same manufacturer and series).
- J. Dual technology occupancy sensors intended for use with digital room management systems shall be fully compatible with other digital room management lighting control components. Basis of design product: *WattStopper LMDC-100* (Ceiling Mounted) and *WattStopper LMDX-100* (Corner Mounted), or prior approved equals by list of accepted manufacturers in lighting digital room controller portion of this specification section.

2.9 WIRING DEVICE ACCESSORIES:

- A. Wall Plates: Provide one piece wall plates for wiring devices, with ganging and cutouts as indicated. Provide blank plates for all unused outlet boxes. Provide with metal screws for securing plates to devices, screw heads colored to match finish of plate, and wall plates possessing the following additional construction features:
 - 1. Material and Finish: Type 302 stainless steel in finished spaces and stamped steel in unfinished spaces.
 - 2. Wall plates for surface raceway boxes shall be of the same width as the surface raceway boxes.
 - 3. All plates shall be mid-size size.
- B. Weatherproof Covers: All devices installed outdoors shall be provided with weather proof covers. Covers shall be *Intermatic* die-cast WP series (or equivalent), single or two gang type. The assembly shall be *UL* listed for wet locations, when in use.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

- A. General:
 - 1. Devices of the same type shown side-by-side shall be gang-mounted and installed under a common plate unless specifically noted.
 - 2. Do not install receptacles within 6" of the edge of sinks.
 - 3. Provide weatherproof covers for all devices installed outdoors.
 - 4. All receptacles installed outdoors, all kitchen receptacles, and receptacles within 6' of

- sinks and other interior receptacles specifically indicated shall be GFCI type.
5. All receptacles installed outdoors shall be weather resistant GFCI type.
 6. Coordinate location of electric water cooler receptacles with cooler manufacturer's recommendations.
 7. All receptacles installed in patient care areas shall be hospital grade.
 8. All receptacles installed in the following locations shall be tamper-resistant type:
 - a. Dwelling units, dormitories, guest rooms and guest suites of hotels and motels.
 - b. Child care facilities.
 - c. Preschools and elementary education facilities.
 - d. Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities.
 - e. Subsets of assembly occupancies described in *NEC 518.2* to include places of waiting transportation, gymnasiums, skating rinks, and auditoriums.

B. Connections:

1. Make connections to side terminals only. Wrap side of device with two complete turns of 600V electrical tape, to cover the exposed terminals.
2. See Section 262010 for conductor requirements.

C. Labeling:

1. Provide engraved device plates where indicated. Use 1/8" high black letters.
2. Device plates for receptacles in patient care areas shall have circuit designation engraved in 1/8" high black letters.
3. Mark the branch circuit to which the device is connected on the back of each device plate, using an indelible marker pen.

3.2 DIMMERS:

- A. In multi-circuit homeruns, provide separate neutrals for each circuit. Do not use a common neutral.

3.3 OCCUPANCY/VACANCY SENSORS:

- A. Corner mounted sensors shall be ceiling bracket mounted where ceiling is present and no higher than 12' AFF. Where space has no ceiling or ceiling is higher than 12' AFF, the corner mounted sensor shall be mounted 10' AFF on a manufacturer-supplied wall bracket.
- B. Sensors shall be installed in locations shown on manufacturer submitted shop drawings.
- C. Connect low voltage momentary switch(es) to sensor power-pack to achieve manual-on/automatic-off operation in the configuration shown on plans. Switch(es) shall allow manual-off operation as well.
- D. Wall mounted sensors shall also be configured to operate manual-on/automatic-off, in configuration shown on plans.
- E. Low-voltage sensor cable shall be supported by j-hooks attached to structural members, and shall be run at right angles with respect to building structure.

- F. Adjust time-off delay to a minimum of fifteen minutes
- G. Test all sensors to ensure that they are operating properly.]

3.4 TESTING:

- A. Test all devices to ensure proper polarity and grounding.

3.5 PROTECTION:

- A. If painting and other finish work occurs after device installation, protect device and conductors by installing and maintaining temporary cover:

END OF SECTION 262020

- C. Where an equipment nameplate has a listed SSCR lower than the available fault current of the electrical system at the point of distribution from the panelboard serving that piece of equipment, The safety switch shall be fusible type installed with current-limiting time-delay fuses. *It is the responsibility of the electrical contractor to coordinate the peak and RMS let-through current of the actual fuse being installed to ensure the potential fault current is smaller than the listed SSCR value.*
- D. **Nameplates shall be screwed and glued to the enclosure.**
- E. Enclosures: NEMA 1 general purpose enclosures indoors, NEMA 3R enclosures where noted or shown on drawings or exposed to weather.

2.2 MOTOR RATED SWITCHES:

- A. Switches shall be toggle-type, without overload protection, rated for the applied voltage and motor load.
- B. Label same as specified for disconnect switches, except install label on wall adjacent to switch.

2.3 ARC FLASH WARNING LABELS:

- A. All safety and disconnect switches shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of NFPA 70 and NFPA 70E.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Coordinate safety and disconnect switch installation with surrounding equipment to provide clearance and workspace based on the voltage encountered, and to insure that the switch is within sight of the controller or driven equipment.
- B. Group and lace conductors within enclosure with nylon tie straps.
- C. **Location of safety switches shall be coordinated with the equipment installer.** Do not proceed with rough-in until location has been established.
- D. All switches associated with outdoor equipment shall be located as close to the equipment as possible (when equipment is in a service yard, switches shall also be in the service yard) and mounted such that the top of the switch is no more than 3'-0" above grade. All switches associated with equipment mounted above a lay-in ceiling shall also be located above the lay-in ceiling.

3.2 SPARE PARTS:

- A. Provide 6 spare fuses of each type used.
- B. Equipment listed above shall be turned over to Owner.

END OF SECTION 262021

SECTION 262030 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION:

- A. This section of the specifications is applicable to all lighting fixtures and fixture accessories.
- B. Fixtures shall be furnished with drivers installed.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturer's:
 - 1. Lighting fixtures - see fixture schedule on drawings.
- B. Submittals: Refer to Paragraph 3.05 and Section 260120.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES:

- A. Provide lighting fixture assemblies complete with all hardware and accessories needed to install and connect, as indicated on the drawings and this section of the specifications.
- B. The Contractor shall select the voltage and frame type based on the use shown, on an area-by-area basis. These modifiers are not included in catalog numbers. (i.e. A given fixture may be required for use on more than one voltage. Determine voltage by circuit to which fixture is connected.)
- C. Any fixtures that are defective or damaged shall be replaced with new. This includes, but is not limited to scratches, dents, inconsistent finishes, etc. The Design Professional's opinion shall be final in making the determination.

2.2 LED LAMPS AND FIXTURES:

- A. General:
 - 1. LED lamps and driver shall have a 5-year warranty or longer.
 - 2. LED fixtures shall have minimum rated life of 50,000 hours or longer per LM 80 and LM 70 standards.

3. Replacement lamps shall have minimum efficiency of 70 lm / W per LM 79 testing.
4. Integral LED lamps shall have minimum efficiency of 90 lm / W per LM 79 testing.
5. Refer to light fixture schedule on drawings for color temperature.
6. Provide minimum Color Rendering Index, CRI, of 80.

2.3 DRIVERS:

A. General:

1. Provide the number of drivers in each fixture to achieve the switching operations indicated. Drivers shall serve only the LEDs within the same fixture; master / slave wiring is not acceptable. This does not preclude the sharing of drivers for fixtures installed in continuous rows.
2. Drivers shall have a minimum starting temperature of 0 F and be rated for a maximum ambient temperature of 105 F.
3. Drivers shall have a 5-year warranty and shall include replacement driver assembly and reasonable replacement labor costs.

2.4 EMERGENCY DRIVERS:

A. Fixtures shown to have integral backup power shall be provided with emergency type battery packs conforming to the following:

1. LED Emergency drivers shall be *IOTA ILB-CP10* or equal by *Bodine*. LED emergency driver shall provide a minimum of 10W of power through constant power technology for 90 minutes. Driver shall have a 5-year warranty.

B. Emergency drivers shall be factory installed.

C. Drivers installed in fixtures located outdoors or unheated spaces shall be suitable for the ambient temperatures encountered.

2.5 FRAMES AND HOUSINGS:

A. Fixture catalog numbers indicate style of fixture required. Provide fixtures with proper frames for ceiling types indicated on the reflected ceiling plan.

B. Fixtures installed in inaccessible ceilings shall be *UL* approved for through wiring and all components shall be accessible from below.

2.6 PENDANT MOUNTED FIXTURES:

A. Provide fixtures of lengths indicated.

B. Provide all suspension assemblies, canopies and accessories required for complete installation.

C. Linear type fixtures shall be supported at all points with stainless steel aircraft cable or rigid stems, as indicated.

1. General:

- a. Provide only one feed point per row of fixtures, unless separate emergency power connection is required.
 - b. Provide supports at every fixture junction and terminus and as stipulated by the manufacturer.
 2. Aircraft cable:
 - a. Provide manufacturer's stainless steel aircraft cable assembly with canopy, for the specific fixture series.
 - b. Provide non-coiled cable securely attached to aircraft cable at feed points.
 3. Rigid stems:
 - a. Provide manufacturer's stem-canopy for the specific fixture series.
- D. Circular type fixtures shall be provided with suspension assemblies specified for each fixture type.
- E. Installation drawings shall be provided for each room, as specified in Section 260120. Show all points of support and feed locations.
- F. Provide one pint of touch-up paint for each fixture type and color.

2.7 COLORS AND FINISHES:

- A. The color / finish of all surface and pendant mounted fixtures and all suspension assemblies, canopies and accessories shall be selected by the Design Professional, from the manufacturer's premium color / finish group. Submittals shall include color charts of the colors / finishes available.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. General:
 1. Do not use permanent fixtures to provide temporary construction lighting. No fixture shall be installed until the interior of the building is enclosed, conditioned, clean and free of dust.
 2. Install lighting fixtures in accordance with the fixture manufacturer's written instructions
 3. Fasten fixtures securely to the indicated structural support members of the building; and check to ensure that solid pendant fixtures are plumb.
 4. Lay-in fixtures shall be supported independently of the suspended ceiling framing members by at least two tie wires located on opposite corners of each fixture.
 5. Fixtures other than lay-in type shall be securely fastened in accordance with *NEC Article No. 410.36 (B)*.
 6. Fixtures installed in rated ceilings shall comply with the *UL Fire Resistance Directory* for the ceiling design encountered.
- B. Layout:
 1. Locate fixtures as indicated on the reflected ceiling plans.
- C. Recessed Fixtures:
 1. It is anticipated that piping and ductwork systems will be installed prior to the installation

of ceiling systems and lighting fixtures. Coordinate recess depth of fixtures, on an area-by-area basis, with other trades, to ensure that sufficient recess depth is maintained.

2. Maintain clearance from thermal insulation and combustible materials as required by the *NEC*.
- D. Pendant Mounted Fixtures:
1. Install fixtures at the heights indicated on the reflected ceiling plans. Fixtures or rows of fixtures shall be true and level.
 2. Suspension assemblies shall be rigidly attached to the building structure. Suspension assemblies shall allow field adjustment of +/- 12".
- E. Emergency fixtures:
1. Where emergency fixtures with integral emergency drivers are shown to be switched, pull an unswitched phase conductor to emergency driver.
 2. Do not switch emergency fixtures connected to the emergency generator. Exception: Fixtures connected to dimming systems.
 3. Do not switch exit lights.

3.2 AIMING:

- A. Aim adjustable fixtures to provide a uniform wash of the surface or area to be illuminated.

3.3 CLEANING:

- A. Prior to final inspection, clean lighting fixtures in a manner recommended and approved by the manufacturer.
- B. Replace any components that are damaged.
- C. Specific attention is directed to the appearance of pendant mounted fixtures. Field touch-up of the finish will only be acceptable when:
 1. The level of damage to the finish does not require replacement of the product, in the sole opinion of the Design Professional.
AND
 2. The Contractor ordered and took delivery of touch-up paint, as well as the manufacturer's recommendations on touch-up, at the time the product was ordered.
AND
 3. The touch-up is acceptable to the Design Professional.

3.4 SPARE PARTS:

- A. Provide [6] spare exit lights and 25' of associated raceway and conductors to connect to nearest un-switched lighting circuit. Spare signs shall be added in locations where the Authority Having Jurisdiction [State Fire Marshal] requires.
- B. Provide [6] spare emergency drivers for linear fixtures. Spare drivers shall be installed in already placed fixtures where Authority Having Jurisdiction [State Fire Marshal] requires.

C. If spare equipment listed above are not needed for installation, turn over to Owner.

3.5 TESTING:

- A. Test all fixtures for proper operation. Replace LEDs and drivers that are not working properly.
- B. Test the emergency lighting system by opening the main circuit breaker serving the facility.
 - 1. Schedule the test with all trades to ensure the tests will not have adverse effects on other equipment and to make sure that other systems properly shut-down and restart.
 - 2. The test shall be conducted at night, in the presence of the Design Professional, Using Agency and State Fire Marshal.
 - 3. The assembled persons will walk the project to:
 - a. Verify operation of equipment installed.
 - b. Review lighting levels on an area-by-area basis.

END OF SECTION 262030

SECTION 262040 - MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Individual low-voltage motor controllers or starters shall be furnished for each piece of driven equipment if not furnished integrally.
- B. All motor controllers furnished shall be horsepower rated in *NEMA* Standard sizes for the size motor served, shall comply with all *UL*, *NEC*, and *NEMA* requirements, and shall provide overload protection in every ungrounded phase conductor servicing each motor. *IEC* controllers shall not be acceptable. All overload units for controllers shall be ambient-compensated type when controllers are located in a varying temperature atmosphere and the motor is located in a constant temperature atmosphere.

1.3 QUALITY ASSURANCE:

- A. Acceptable manufacturers: *Allen-Bradley Co.*, *General Electric Co.*, *Square D Co.*, *Cutler Hammer*, *Siemens*.
- B. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 MANUAL CONTROL:

- A. For 115-volt, single-phase motors, motor controllers shall be toggle-type, manually operated thermally protected, across-the-line starting type, unless otherwise indicated or unless automatic starting is required. Controller shall also serve as the disconnecting means unless indicated otherwise.
- B. Provide *NEMA 1* enclosure for all indoor, dry locations and *NEMA 3R* enclosure for outdoor or wet locations.

2.2 AUTOMATIC CONTROL:

- A. For 3-phase motors 25 HP and smaller, motor controllers shall be magnetically operated, across-the-line starting type, unless otherwise indicated. 30 HP and larger shall use reduced

voltage auto-transformer type units. Starters shall be equipped with Hand-Off-Automatic switch.

- B. Combination motor controllers shall have externally operated molded-case circuit breakers properly sized for the motor or equipment serviced, mounted and factory wired in the same enclosure with the motor controller.
- C. Control power transformers complete with necessary fuses shall be provided, unless otherwise indicated, in the motor controller enclosure for all electrically operated motor controllers and associated control equipment. Control voltage shall be 120 volts, 60 Hz., unless otherwise indicated. Transformers shall be adequately sized for operation of the motor controller and auxiliary equipment associated therewith.
- D. Necessary extra interlocks and cover mounted control devices, as required, shall be provided.
- E. Provide red "run" pilot light and blue "overload" pilot light in cover.
- F. Starters shall have engraved plastic nameplates indicating the load served, load rating and the branch circuit number. **Nameplates shall be screwed and glued to enclosure.**
Ex: EF-1
2HP, 3 phase, 208V
HA-1
- G. Provide *NEMA 1* enclosure for all indoor, dry locations and *NEMA 3R* enclosure for outdoor or wet locations.

2.3 ARC FLASH WARNING LABELS:

- A. All motor starters shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of *NFPA 70* and *NFPA 70E*.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation by the Contractor shall include firmly mounting motor controllers with overload re-set button or switch, or with operating handle of circuit breaker or switch for combination types, not over 6'-6" above the floor or finished grade, All bolts, lugs and other connections shall be checked for tightness. All moving parts shall be checked for proper alignment and freedom of movement. All time-delay or sequencing relays shall be checked and properly adjusted or set.
- B. Coordinate controller installation with surrounding equipment to provide clearance and workspace based on the voltage encountered.
- C. Controllers shall be checked for installation of properly sized overload heater units and all breaker instantaneous trip units shall be set as low as possible to allow motor to start.

D. All motors on motor operated equipment shall be checked for proper rotation.

END OF SECTION 262040

SECTION 262042 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide panelboards as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products by one of the following (for each type of panelboard and enclosure): *General Electric Company, Square D Co., Cutler Hammer, Siemens*.
- B. Compliance / Labels:
 - 1. Equipment shall comply with the latest applicable standards of *NEMA PB-1* and *UL 67*.
 - 2. Where panelboards are used as service entrance equipment, they shall comply with all *NEC* and *UL* requirements for service entrance and a *UL* service entrance label shall be provided.
- C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 ENCLOSURES:

- A. Enclosure shall be constructed of code gauge steel constructed **without** knockouts. Provide manufacturer's standard light gray finish.
- B. Provide double hinged door with flush metal latch/lock on inner door. Inner door shall provide access to circuit breaker operating handles only, not to energized parts. Outer continuous piano hinged door shall be mounted to the panelboard box with factory screws and shall provide access to energized parts; metal latch/lock is not permissible on outer door. Both inner and outer doors shall open in same direction.
- C. All locks shall be keyed alike.
- D. Provide metal or *Lexan* interior circuit directory frame with card and clear plastic covering.
- E. Panelboard enclosures shall be *NEMA 1* unless shown to be installed in damp or wet locations. In such locations, enclosures shall be *NEMA 3R* or *4X*.

2.2 CONSTRUCTION:

- A. Provide dead-front safety type panelboards of either Power and Distribution type or Lighting and Appliance type as defined by the *NEC*.
 - 1. Power and Distribution type panelboards shall be a minimum of 32" wide by 9" deep and a maximum of 44" wide by 12" deep.
 - 2. Lighting and Appliance type panelboards shall be a maximum of 20" wide by 5-3/4" deep.
- B. Panels shall be equipped with copper bus bars, full-sized neutral bar, and an equipment ground bus. Panels serving computer receptacles shall have a isolated ground bus in addition to the equipment ground bus.
- C. Each panel shall be equipped with main lugs or main breaker, as indicated.
- D. Two section panels shall be through-feed type and shall be installed with cans abutting. *Cans and covers shall be of same size, for both sections.* Divide circuits as evenly between the two sections as possible.
- E. Provide with laminated plastic nameplate engraved with name of panel, voltage, ampere rating/type fault current rating, date, and feeder origination. Nameplate shall be screwed and glued to panel. Nameplates shall be black in color with white lettering. Nameplates shall have beveled edges.

Example (not actual panel on project): Panelboard HA
277/480V, 3 phase, 4W
225A Main Lugs
14,000 AIC
Fed from SWBD
9/2019

2.3 CIRCUIT BREAKERS:

- A. Provide bolt-in type, heavy duty, quick-make, quick-break, thermal, magnetic molded case circuit breakers. Multi-pole breakers shall be common trip, with a single handle.
- B. Main circuit breakers shall be large frame type, individually mounted, connected directly to the bus. The use of back fed breakers is not acceptable.
- C. Provisions for future breakers shall be fully bussed complete with all necessary mounting hardware.
- D. Devices which achieve the level of fault protection indicated by means of "series" or "integrated" rating shall not be acceptable unless specifically indicated on the drawings.
- E. Breakers serving HVAC equipment shall be HACR type.
- F. Circuit breakers serving fire alarm equipment shall be provided with a lock tab, red in color.

G. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200 amps or higher, provide an energy reducing maintenance switch with local status indicator.

2.4 BRANCH CIRCUIT IDENTIFICATION:

A. All panelboards shall have a legend permanently posted to their exterior frontal enclosure identifying phasing and the color scheme of all ungrounded conductors in accordance with *NFPA 70, Article 210.5*.

2.5 METERING:

A. On panelboards used as service equipment, provide *Siemens 9330*, complete with current transformers and interconnecting wiring, all rated for 1% accuracy. Unit shall be factory installed and tested. Flush mount meter in termination compartment. Equivalent metering by *Westinghouse, G.E.* or *Square D* is acceptable.

2.6 WARNING LABELS:

A. All panelboards shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of *NFPA 70* and *NFPA 70E*.

B. Where panelboards are used as service equipment, provide separate label to show the maximum available fault current. Label shall have blank fields to handwrite the calculated available fault current and the date calculated. After service is installed and ready to be inspected by the Authority Having Jurisdiction [Design Professional], Contractor shall submit to the Electrical Engineer the fault calculation (at the service entrance only).

PART 3 - EXECUTION

3.1 GENERAL:

A. Provide circuit directory upon completion of work. Identify load served and location (by room name and number) assigned by user, not by room numbers on floor plans. Note spares and spaces as such. Create directory using electronic spreadsheet and print in 8-1/2"x11" format using as many pages as necessary. Fold and place in directory holder.

B. Do not splice conductors in panelboard enclosure.

C. Only one conductor shall be connected to each terminal or lug.

D. Connect circuits 1 and 2 to phase A; 3 and 4 to phase B; 5 and 6 to phase C., etc. Conductors shall be color coded in accordance with Section 262010.

E. Group and lace conductors within panel enclosure with nylon tie straps.

- F. Each section of two section panels shall contain only those conductors which originate in that section. Do not use panel as a wireway.

3.2 GROUNDING:

- A. Ground all panels in accordance with details on the drawings and Section 262080.
- B. Do not bond neutral and equipment grounding conductors within panelboard unless panel is used as service equipment or are a separately derived system.

3.3 ADJUST AND CLEAN:

- A. Adjust operating mechanism for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.
- C. Clean all debris from panel interiors.
- D. Clearance and Workspace: Maintain workspace and clearances as required by the NEC for the voltage encountered. No pipes or ducts shall pass above the outline of the panelboard. It shall be the responsibility of this Contractor to make sure that other trades do not encroach on this space.

END OF SECTION 262042

SECTION 262044 - SEPARATELY ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide circuit breakers of ratings as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturers: *General Electric Co., Square D Co., Cutler-Hammer, Siemens.*
- B. Compliance/Labels:
 - 1. Equipment shall comply with the latest applicable standards of *NEMA PB-1* and *UL 67*.
 - 2. Where circuit breakers are used as service entrance equipment, they shall comply with all *NEC* and *UL* requirements for service entrance and *UL* service entrance label shall be provided.
- C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide circuit breakers, enclosures and auxiliary components of types, sizes and ratings indicated. Enclosure shall be *NEMA 3R* outdoors and be constructed of code gauge steel constructed without knockouts. Provide manufacturer's standard light gray finish.

2.2 CIRCUIT BREAKERS:

- A. Circuit breakers shall the same type as specified in the PANELBOARDS section.

2.3 NAMEPLATE:

- A. Nameplates shall be the same as specified in the PANELBOARDS section.

2.4 SPECIAL PROVISIONS:

- A. Circuit breakers located in elevator machine rooms, serving the elevator motor and car lights shall be provided with a shunt trip coil rated for 120V operation. Breaker shall also have a set of Form C contacts.

2.5 ARC FLASH WARNING LABELS:

- A. All separately enclosed circuit breakers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of *NFPA 70* and *NFPA 70E*.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Do not splice conductors in circuit breaker enclosure.
- B. Group and lace conductors within enclosure with nylon tie straps.

3.2 ADJUST AND CLEAN:

- A. Adjust operating mechanism for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

END OF SECTION 262044

SECTION 262047 - DRY TYPE TRANSFORMERS, 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide dry-type transformers of ratings indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE:

- A. Transformers shall be the standard product of one of the following manufacturers: *General Electric Company, Square D Company, Siemens, Cutler-Hammer.*
- B. Compliance: Comply with applicable *UL, NEMA* and *ANSI* publications pertaining to dry type transformers and their installation.
- C. Submittals: Refer to Section 260120 for requirements.

PART 2 - PRODUCTS

2.1 TRANSFORMERS:

- A. Individual dry type transformers shall be *UL* approved for 500 KVA and smaller, shall be sized as indicated on the drawings, shall be built in accordance with *NEMA/ANSI* standards, shall be self-cooled, two-winding type, and shall have totally enclosed **copper** windings. Transformers shall be rated for a **115 C rise** above ambient. Provide weather-proof enclosures for all units mounted in locations exposed to falling or driven rain.
- B. Full capacity taps shall be provided in the high voltage windings and shall have 4-2-1/2% taps below and 2-2-1/2% taps above rated primary volts. Transformer impedance value shall be manufacturer's standard for size transformer provided.
- C. Transformer sound levels shall be based on *NEMA-ANSI* standards. *However, no audible noise shall be heard outside the rooms in which transformers are located, under all load conditions. Transformers not meeting this requirement shall be replaced.*
- D. Transformers shall have efficiencies in compliance with federal law *10 CFR Part 431* standards.

2.2 ARC FLASH WARNING LABELS:

- A. All dry type transformers shall have arc flash warning labels field affixed to their enclosures that comply with the requirements of *NFPA 70* and *NFPA 70E*.

PART 3 - EXECUTION

3.1 TRANSFORMER INSTALLATION:

- A. Installation of transformers shall be such that air circulation around the units is not restricted. Hold 6" off walls.
- B. The transformer taps shall be connected to provide proper operating secondary voltage.
- C. Transformers shall be floor mounted type. Install on floor or suspend, as indicated on the drawings. Floor mounted transformers shall be installed on a 4" high concrete pad with 3" overlap on all sides. Anchor transformer to pad. *Coordinate exact placement with sprinkler system installer such that during normal operation, the heat rejected from transformer does not cause activation of sprinkler head.*
- D. Transformers mounted indoors shall have neoprene, rubber or similar type vibration dampening mounts. Mounts shall be rubber-in-shear type composed of two metal parts with rubber compound in between. All raceway connections shall be made with 12" to 18" of flexible metallic conduit.
- E. Ground transformer secondary neutral to the nearest electrode in accordance with *NFPA 70, Article 250-26c*.

END OF SECTION 262047

SECTION 262049 - SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide SPD units connected in parallel with power distribution equipment, as indicated. SPD units shall be mounted *external* to power distribution equipment. *The use of SS/EHF units integral with power distribution equipment is not acceptable.*

1.3 COORDINATION:

- A. Work under this section shall be closely coordinated with power distribution equipment specified under other sections.

1.4 REFERENCE STANDARDS AND PUBLICATIONS:

- A. Suppressors shall be designed, manufactured, tested, and installed in accordance with the latest edition of the following guidelines and standards:
 1. *ANSI/IEEE C62.41.1 & C62.41.2.*
 2. *ANSI/IEEE C62.45.*
 3. *UL 1449 Third Edition.*
- B. Provide certification that product performance has been verified by a nationally recognized third-party testing laboratory.

1.5 SUBMITTAL:

- A. Refer to Section 260120 for requirements.

1.6 ACCEPTABLE MANUFACTURERS:

- A. This specification is based on the following: *Square D, Surge Suppression, Inc., Current Technologies, Advanced Protection Technologies, Eaton, Liebert, Intermatic, DITEK.*

PART 2 - PRODUCTS

2.1 GENERAL:

A. SPD for service equipment:

1. Type 1 [Type 1] device.
2. Voltage: [120/240, 1-PH, 3-W], [120/208, 3-PH, 4-W], [277/480V, 3-PH, 4-W], 60 Hz.
3. Modes: L-L, L-N, L-G.
4. Single pulse surge capacity per mode: [240,000] [] amps.
5. Clamping Voltage: Manufacturer's rating per the distribution system's voltage.
6. Noise Attenuation: 100KHz - 100MHz.
7. Nominal Discharge Current (In) shall be a minimum of 20kA.

B. SPD for lighting and appliance panels:

1. Type 2 device.
2. Voltage: [120/240, 1-PH, 3-W], [120/208, 3-PH, 4-W], [277/480V, 3-PH, 4-W], 60 Hz.
3. Modes: L-L, L-N, L-G, N-G.
4. Single pulse surge capacity per mode: minimum of 120,000 amps.
5. Noise Attenuation: 100KHz - 100MHz.
6. Nominal Discharge Current (In) shall be a minimum of 10kA

2.2 FEATURES:

A. All units shall have the following features:

1. Phase LED indicator lights.
2. Disturbance counter.
3. 10-year repair / replacement warranty from manufacturer in the name of the Owner.

2.3 ENCLOSURES:

- A. SPD enclosures shall be *NEMA 1* unless shown to be installed in damp or wet locations. In such locations, enclosures shall be *NEMA 3R* or *4X*.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide an SPD unit on each piece of service entrance equipment [and at each panelboard serving computer receptacles].
- B. Install adjacent to electrical equipment, ensuring that lead lengths are as short as possible to achieve the level of protection specified herein. Lead lengths longer than 12" is unacceptable. Where field conditions make this requirement impossible, contact Design Professional during shop drawing phase before electrical room drawings are submitted.
- C. Connect to circuit breaker in electrical equipment as shown on the manufacturer's wiring diagrams.

END OF SECTION 262049

SECTION 264000 – SEISMIC CONTROL FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The drawings and general provisions of this division of the Contract, including the General and Special Conditions and Division 01 Specifications, apply to this Section.
- B. Additionally, the following sections apply to this section:
 - 1. Section 260100 – Electrical General Provisions.
 - 2. Section 261010 – Raceway Systems and Supports.

1.2 SCOPE OF WORK:

- A. Furnish all labor, materials, tools, and equipment and perform all work necessary to complete the installation of the seismic control systems required by these specifications and as detailed on the drawings.
- B. All foundations and supports required for the installation of Division 26 equipment shall be furnished by the Division 26 contractor unless specifically specified otherwise.
- C. All concrete work, forming, framing, pouring and materials shall be furnished under Division 01 of the contract documents.

1.3 QUALITY ASSURANCE:

- A. Codes and Standards: The installation of the Electrical systems shall be installed in accordance with the following codes and standards. All seismic restraint systems such as sway bracing, cable restraints, seismic restraints, etc. shall also meet the requirements as set forth in the following standards and codes:
 - 1. *The International Building Code (IBC)*
 - 2. *National Electric Code, NFPA 70*
 - 3. *SMACNA Seismic Restraint Manual*
 - 4. *ASTM 488 Anchor locations*
 - 5. *FEMA Standards*
- B. The seismic control equipment and products shall be sized and provided by one of the manufacturers listed below. The manufacturer shall have tested all seismic products provided for the specific intended use and installation.
- C. The following list of manufacturers are acceptable manufacturers: *Kinetics Noise Control, Mason, Amber/Booth, Vibration Mountings and Controls.*
- D. The manufacturer and/or his representative shall select all seismic control products in accordance with these specifications and all applicable codes. All products shall provide the protection indicated based on the actual equipment weights and installation requirements of

the approved equipment. The manufacturer shall provide installation instructions for all provided seismic restraints and bracing.

- E. Submittals: The contractor shall submit for approval by the engineer, seismic anchorage requirements for all equipment and raceway systems. Anchorage calculations shall be prepared by a registered engineer and in the state where the project will be constructed. The engineer shall stamp calculations. Anchorage requirements shall be submitted for all base mounted equipment, suspended equipment, and roof mounted equipment. Seismic anchorage calculations shall include an "anchorage schedule" for the contractor's use. The anchorage schedule shall list the equipment, the size and quantity of fasteners and the minimum embedment depth of anchors. Calculations may be combined for similar types of equipment provided the size and weight does not vary more than 15% and the installation manner are similar.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All equipment shall be mounted or suspended from approved foundations and supports as specified herein.
- B. All seismic control devices shall be listed for the intended use. It is the responsibility of the Contractor to determine the appropriate restraint methods with respect to the building type and the specific equipment used.

2.2 SEISMIC CONTROL:

- A. The electrical systems serving the building shall be installed to meet the minimum requirements of the *International Building Code* regarding seismic protection and control. These specifications and the drawings indicate the minimum requirements and general intent. The actual requirements shall be determined by the seismic engineer and supplier and submitted for approval by the Design Professional.
- B. The seismic engineer shall be a registered engineer in the state in which the facility is constructed and whose principal area of practice is seismic engineering and related fields.
- C. All equipment installed either floor or pad mounted, suspended from the structure or roof mounted on curbs shall be restrained and anchored unless exempt as hereinafter indicated.
- D. The following criteria applies to this project:
 - 1. Seismic Design Category: (A,B,C,...F)
 - 2. Importance Factor: (1.0 or 1.5)
- E. Where conduits, cable trays, or other electrical systems cross the seismic isolation interface between two seismically isolated structures, the systems shall have flexible connections to accommodate the seismic displacement of the two structures. Flexible connectors shall be installed on one side of the interface.

- F. The following electrical components are exempt from seismic bracing or restraints:
 - 1. Components in seismic design category A and B.
 - 2. Components in Seismic Design Category C when the $I_p = 1.0$.
 - 3. Electrical components in all Seismic Design Categories where $I_p = 1.0$, the equipment weight is less than 400 lb, the equipment is installed less than 4'-0" above the floor and flexible connections are installed between the equipment and associated conduit.
 - 4. Electrical components located in Seismic Design Category D, E and F that weigh less than 20 lbs and $I_p = 1.0$, and flexible connections are installed between the component and associated conduit.
- G. Cable trays and electrical conduits located in Seismic Design Category D, E and F shall be supported and seismically braced independently of the suspended ceilings.
- H. Electrical equipment designated to have an $I_p = 1.5$ shall be designed and fabricated to withstand the horizontal forces as determined by the *2018 International Building Code*, and the manufacturer shall certify and provide certification that the equipment meets this requirement of the code.
- I. Batteries installed on battery racks when $I_p = 1.5$ shall be provided with wrap around seismic restraints to prevent batteries from falling off racks. Racks shall have sufficient lateral restraints to resist the horizontal forces.
- J. All life safety systems and associated equipment and conduit installed in the building such as emergency lighting systems, exit signs, fire alarm systems, fire protection systems and smoke removal systems shall have an importance factor of 1.5. Systems having an importance factor of 1.5 shall be restrained.
- K. All electrical equipment that is floor mounted and weighs 400 lbs or more shall be restrained.
- L. All electrical equipment located in Seismic Design Category D, E or F and installed 4'-0" or more above the floor and weighs more than 20 lbs shall be restrained. In addition, flexible connectors shall be provided between the equipment and connecting conduit.
- M. Electrical components, equipment, and conduit containing hazardous or flammable material shall have an importance factor of 1.5 and shall be restrained.
- N. Components and systems needed for continued operation of essential facilities shall be restrained.
- O. Anchorage of equipment to concrete floors and pads shall be in accordance with the submitted anchorage calculations.
- P. Connections of seismic restraint cable hardware shall be in accordance with the submitted anchorage calculations.

PART 3 - EXECUTION

3.1 GENERAL:

- A. If the equipment provided is not furnished with integral structural steel supports, mounting feet, or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the seismic restraints as specified herein.
- B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.
- C. All seismic restraint products shall be installed as outlined in the manufacturer's printed installation instructions.

3.2 SEISMIC CERTIFICATE OF COMPLIANCE:

- A. The manufacturer's representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of seismic control products.
- B. The manufacturer's representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer's installation instructions. Upon satisfaction that all devices are installed correctly, the representative shall submit a written report outlining that the installation is in compliance with these specifications as well as the manufacturer's installation instructions.

END OF SECTION 264000

SECTION 265000 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. The work required under this section of the specifications consists of the layout and installation of a **functional and unobtrusive** lightning protection system for the entire facility. All materials and devices which are an integral part of the lightning protection system shall be provided under this section of the Specifications.
- B. Definitions: Terms as defined in *NFPA 780* shall apply to this section.

1.3 RELATED WORK:

- A. The electrical grounding system is specified in Section 262080.
- B. Grounding of systems above 600V is specified in Section 263030.

1.4 QUALITY ASSURANCE:

- A. The following standards are incorporated into and become a part of this specification by reference.
 1. *National Electric Code (NFPA 70)*.
 2. *Lightning Protection Code (NFPA 780)*.
 3. *IEEE Std 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems*.
 4. *Underwriters Laboratories, Inc.*

1.5 LIGHTNING PROTECTION COMPONENTS:

- A. *96A - Installation Requirements for Lightning Protection Systems, Lightning Protection Institute.*
- B. *LPI-175 - Lightning Protection Installation Standard.*
- C. *LPI-176 - Lightning Protection System Material and Component Standard.*
- D. *LPI-177 - Inspection Guide for LPI Certified Systems.*

- E. Acceptable Manufacturers: Firms regularly engaged in manufacture of lightning protection system components, of types, sizes, and ratings required, and who are Class I manufacturer - members of Lightning Protection Institute.
- F. Installer's Qualifications - Firm with at least five years of successful installation experience with projects utilizing lightning protection system similar to that required for this project, and who are Class III, installer - members of *Lightning Protection Institute*.
- G. Submittals:
 - 1. Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Include layout indicating all system components and interconnection with each component identified for this project. Typical layouts are not acceptable. Prepare drawing at a minimum scale of 1/16"=1'-0".
 - 2. Refer to Section 260120 for additional requirements.
- H. *UL Certification*: Comply with *UL 96A, "Master Labeled Lightning Protection Systems."*
- I. Coordination:
 - 1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other Contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access.
 - 2. **Provide a separate letter to the Roofing manufacturer requesting method of attaching materials to and penetrating roof, for each type roof. Engage the services of the roof installer to provide attaching materials and to make and seal all roof penetrations.**

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS:

- A. General: Provide lightning protection system material and components, of types, sizes, ratings, for Class 1 service, which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for complete installation. Materials and all components shall comply with *NFPA 780* and *LPI* standards.
- B. Materials: All lightning protection system materials shall be selected based on building materials present. Basis of design materials, unless inappropriate for building material, are as follows:
 - 1. Air Terminals: Solid aluminum.
 - 2. Main Conductors: Aluminum cable.
 - 3. Secondary Conductors: Aluminum cable.
 - 4. Down Conductors: Copper cable. Use bimetallic connectors when transitioning from aluminum to copper cables.
 - 5. Main Conductors Below Grade: Copper cable.
- C. Copper equipment shall not be connected to aluminum surfaces except by means of an *LPI*

approved bi-metal transition fitting. Lead-coated fittings are not acceptable.

- D. Ground rods shall be the type specified in Section 262080. All rods shall be accessible, (as defined in Section 262080) and shall be provided with a waterproof tag labeled "LIGHTNING PROTECTION SYSTEM".

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS:

- A. Install lightning protection systems as indicated, in accordance with equipment manufacturer's written instructions, and in compliance with applicable requirements of *NEC*, *NFPA 780* and *LPI* to ensure that lightning protection systems comply with requirements.
- B. Coordinate with all trades as necessary to interface installation of lightning protection system with other work.
- C. Install conductors with direct paths from air terminals to ground connections avoiding sharp bends and narrow loops.
- D. **All roof conductors shall be concealed. Provide all necessary components for a concealed system installation.**

3.2 DOWN CONDUCTORS:

- A. Down conductors shall be installed in 1" schedule 40 PVC conduit. All down conductor conduits shall be installed concealed.

3.3 INTERCONNECTION OF METALS:

- A. Provide potential equalization and bonding of metal bodies as required by *NFPA 780*.
- B. Bonding of all metallic objects and systems at roof levels and within the structures shall be complete. Bonds for metal bodies shall consist of, but not be limited to the following: Roof exhaust fans, HVAC units with related piping ductwork, exhaust vents and any other piping systems, antenna mast for TV, radio or microwave, flag poles, roof handrails and/or decorative screens, roof ladders, skylights, metal plumbing stacks, equipment yard fencing, etc. Exterior architectural metal fascia and/or curtain walls or mullions, which extend the full height of the structure shall also be bonded, if not inherently bonded thru the building frame.
- C. Other metal bodies shall be bonded as required by *NFPA 780*. Typical of these are: roof flashings, parapet coping caps, gravel guards, isolated metal building panels or siding, roof drains, down spouts, roof insulation vents and any other sizable miscellaneous metals, etc.

3.4 GROUNDING:

A. Grounding terminals (rods) shall be provided for each down conductor.

B. Bond all rods to building ground ring if present.

3.5 BONDING:

A. Where LPS conductors are installed in metallic raceways, bond conductor to raceway at both ends.

3.6 TESTING:

A. Upon completion of installation of lightning protection system, test resistance-to-ground as specified in Section 262080.

B. Update shop drawings to reflect all field changes.

C. Test and certify the system per *UL*, *NFPA* and *LPI* requirements. Provide *UL* Master Label certification. Permanently affix label in a location approved by the Design Professional.

END OF SECTION 265000

SECTION 26 51 01- ARCHITECTURAL LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provisions of the following sections should be referred to
 - 1. Section 26 51 02 – Architectural Light Fixture Cut sheets
 - 2. Section 26 51 03 – Architectural Lighting Control System

1.2 SUMMARY

- A. General: Provide Lighting in accordance with requirements of the Contract Documents.
- B. Work Included:
 - 1. Provide and install fixtures as shown on the Drawings and schedules complete with all specified lamps, completely wired, controlled and securely attached to supports.
 - 2. Provide all materials, accessories and any other equipment necessary for the complete and proper installation of all lighting fixtures specified herein.
 - 3. Fixture Types: Type of fixture shall be as indicated on the Drawings and as specified below in the Fixture Type Schedule.
 - 4. Lamping: Lamping for each type of fixture shall be as indicated on the Drawings and as specified below in the Fixture Type Schedule.
 - a. Coordination: Coordinate installation, connection, and securing of all lighting fixtures with adjacent construction and with all other applicable trades to provide a total system that is complete and finished in appearance.
 - 5. Completeness: The specifications and Drawings pertaining to this scope of work, are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the complete installation of the work.
 - 6. Minor Details: Minor details, not usually indicated on the Drawings nor specified, but that are necessary for the proper execution, completion and installation of the fixtures, shall be included, as if they were herein specified or indicated on the Drawings.
 - 7. Omissions and Clarifications: Where any fixture type or lamping designated has been omitted or cannot be determined by the Contractor, request a clarification from the Architect and provide the fixture type as directed. Where an inconsistency in the specifications and/or the Drawings is determined by the Contractor, request a clarification from the Architect and provide as directed. There will be no increase in cost permitted to correct any inconsistency within the documents so long as the overall intent of the work scope is not changed.
 - 8. Owner Furnished Contractor Installed Items (O.F.C.I.I): Fixtures specifically designated as O.F.C.I.I in the specifications, or on the Drawings, shall be provided by the Owner to the Contractor, and installed by the Contractor, to the same level of completeness and coordination as afforded all other fixtures in this specification.

C. Bid Instructions:

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COASTAL COMMUNITY CENTER FOR THE ARTS
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PERMIT SUBMITTAL
APRIL 2024

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SECTION 26 51 01- ARCHITECTURAL LIGHTING FIXTURES

1. Provide itemized per unit cost distributor net pricing for all specified fixture types.

1.3 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures.

B. Shop Drawings: Where indicated for specific fixture types below, submit full-size shop drawings cross-referenced to contract documents, indicating name of project, fixture type, construction of fixture, dimensions, material thicknesses, finishes, joints, lamping, anchorages, and relationship to adjacent materials and complete details and/or data of fixtures, including Manufacturer's name, catalog number for lampholders, transformers, ballasts, metal gauges, independent test reports, photometric data, type of wiring, color and texture of finishes.

1. No variation from the general arrangement and details indicated on the contract document Drawings shall be made on the shop Drawings unless required to suit the actual conditions on the project, and then only with the written acceptance of the Architect. All variations must be clearly indicated as such on the shop Drawings submitted for approval.
2. Submit Shop Drawings for all low voltage transformer and power supply locations. Power supply locations shall be indicated via sketch format by the Contractor.
3. Submit full Shop Drawings and full scale samples for all custom fixtures.
4. Submit full Shop Drawings for all remote ballast locations.
5. Submit full Shop Drawings for all Cold Cathode fixture layouts.

C. Samples: Where indicated for specific fixture types in the Fixture Type Schedule, a sample will be required for the purpose of ascertaining its performance, quality of parts and details, maintenance features, method of installation and safety features. Samples must be wired for simple plug-in operation for evaluation purposes. Samples to be shipped prepaid by the Contractor to the Architect, or as otherwise advised. No payment shall be required for samples, and will be submitted at no additional cost to the Owner. Samples submitted for evaluation purposes will not be returned unless a prepaid shipping number is provided by the Contractor, nor are they to be included in the quantities listed for the project.

1. For each sample fixture submitted, submit photometric data from an independent testing laboratory, of the submitted sample.
2. All sample fixtures must be tested and labeled by Underwriters' Laboratories Inc, and bear such label affixed to each fixture in such a position as to conceal it from normal view.
3. Fixture samples and photometric data shall be submitted for final review within thirty (30) days after receipt of reviewed shop Drawings. If after a period of thirty (30) days from submittal of sample, the fixture cannot be made acceptable, then a fixture, (shop drawing and sample), by one of the additional Manufacturers specified, shall be submitted for review at no extra cost to the Owner.
4. Construction time permitting, and then only with the written acceptance of the Architect, sample fixtures may be submitted for review of workmanship and material finishes only, prior to the submittal of the complete working sample. The approval of a sample for workmanship and material finishes, does not negate the requirement for submission of the complete working sample including photometric data and UL label.

D. Product Data:

1. Cut Sheets: For all fixture types where Shop Drawings are not specifically indicated for submission, submit standard Drawings, or cut sheets, including product data and photometric data.

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2. Lamping: For all fixture types submit cut sheets for lamping including: Manufacturer, Manufacturer's catalog number; and quantity of lamps per fixture.
- E. Mock-ups: If required by article, Mock-ups, make submittals required for mock-up construction and obtain necessary approvals prior to commencement of mock-up construction. Submit Mock-up Shop Drawings of each mock-up, showing: materials, dimensions, details, hardware, fixture, lamping, and proposed mock-up location.
1. When Required: Where indicated below, and/or as indicated on the Drawings, provide a mock-up as specifically indicated herein. Where practical, with prior approval of the Architect, mock-ups may be constructed on site, and when approved be incorporated into the project. Mock-ups to be constructed within 90 days of Notice to Proceed.
 2. Performance Requirements: Mock-ups shall be constructed for Architect's review for compliance with the Contract Documents; approval of color, texture, finishes quality, detail and illumination; and shall be used as a standard for the final installation.
 3. Review and Approval: Upon completion of mock-up construction, notify the Architect and make arrangements for review. Modify the mock-up or construct new components if requested by the Architect, until final approval is obtained.
- F. Certifications: With all submittals, provide a statement declaring that all lighting fixtures and fixture Drawings have been coordinated with the Drawings and details of the Architectural, Structural, Electrical, Mechanical, and other related trades to assure an accurate and efficient installation.
- G. Closeout Submittal:
1. Maintenance Manual: Prior to the completion of the project submit, for incorporation into the overall project maintenance manual, recommended maintenance requirements from the manufacturers of each fixture type, including:
 - a. A quantity of two (2) of any special tools required.
 - b. Types of cleaners to be used.
 - c. Replacement parts identification lists and contacts for all fixtures, including all lamping.
 - d. Recommended maintenance schedule and procedures.
 - e. Final as-built shop Drawings for all fixtures that required shop drawing.
- 1.4 QUALITY ASSURANCE

- A. Contractor's Quality Assurance Responsibilities: Contractor is solely responsible for quality control of the Work. Comply with the requirements specified in Section 01 40 00, Quality Requirements.
- B. Quality: All fixtures, lamping, accessories, and materials, shall be new, of good quality, and free from defects which in any manner may impair their character, appearance, strength, durability and function.
- C. Replacement of Damaged Fixtures: All blemished, damaged, or unsatisfactory fixtures shall not be installed. All blemished, damaged, or unsatisfactory fixtures shall be replaced in a satisfactory manner as directed by the Architect.
- D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

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- E. Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the National Electrical Code as verified by Underwriters' Laboratories Inc., or other testing agency as acceptable to local code authorities. Such a listing shall be provided for each fixture type, and the appropriate applicable regulatory agency label or labels shall be affixed to each fixture in such a position as to conceal it from normal view. Listing and labels shall be provided for wet locations as required, and as specified herein.
- F. Substitutions: The lighting designated for this project is based on fixture types and lamping as specified. Identification of specified fixtures and lamping by means of Manufacturers' names and catalog numbers is to establish specific features, aesthetics and performance. Any substitutions must meet or exceed these standards. If substitution of fixtures, and/or lamping, other than those specified is desired, provide the following information noted below, for both the specified fixture and lamping, and the proposed equal substitute fixture and lamping, for evaluation by the Architect. All substitution requests must be submitted in accordance with Section 01 25 00, Product Requirements.
1. Fixtures submitted for substitution are required to have been in commercial use for at least one (1) year unless otherwise noted.
 2. Submit all performance data noted below in paragraph, Equality.
 3. At the discretion and request of the Architect, and at no additional cost to the Owner, provide lamped, working samples of both the specified fixture and the proposed substitute fixture for evaluation by the architect. Samples must be wired for simple plug-in operation for evaluation purposes. Samples to be shipped prepaid by the contractor to the Architect, or as otherwise advised. Samples submitted for evaluation purposes will not be returned, nor are they to be included in the quantities listed for the project.
- G. Approved Additional Manufacturers: The lighting designated for this project is based on fixture types and lamping, as specified. Identification of specified fixtures by means of Manufacturers' names and catalog numbers is to establish specific features, aesthetics and performance.
1. Where Approved Additional Manufacturers are listed for a particular fixture type, a substitute fixture from that Manufacturer may be submitted to the one specified. The fixture must still meet all of the performance requirements noted below in paragraph, Equality, and must be submitted for evaluation by the Architect in accordance with Section 01 25 00, Product Requirements.
 2. Where an Approved Additional Manufacturer and specific fixture catalog numbers are listed for a particular fixture type, the specified fixture from that Manufacturer may be submitted as an equal fixture to the one specified. The fixture must still be submitted for review by the Architect in accordance with article, Submittals.
- H. Qualifications: Within thirty (30) days of award of bid, Contractor must furnish all required data and samples, noted in paragraph, Substitutions, for all substituted fixtures, and/or lamping, including substitution requests and associated Manufacturers. If fixture fails to comply with the specification requirements at that time, Contractor will furnish specified fixture at no additional cost to the Owner, and with no delay to the project.
- I. Equality: Equality shall be determined by comparisons of actual fixtures, lamping, and of the following fixture and lamping characteristics. The Architect shall be the final authority with respect to equality.
1. Performance:
 - a. Photometric data.
 - b. Distribution.
 - c. Utilization.
 - d. Efficacy.
 - e. Efficiency.

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- f. Average brightness/maximum brightness.
- g. Spacing to mounting height ratio.
- h. Visual comfort probability.
- i. Ballasts.
- j. Transformers.
- k. Heat dissipation.
- 2. Construction:
 - a. Engineering.
 - b. Workmanship.
 - c. Rigidity.
 - d. Types of materials.
 - e. Thicknesses and gages of fixture materials.
 - f. Light tightness, no light leaks will be accepted.
 - g. Permanence and quality of materials and finishes.
 - h. Physical Dimensions, both visible, and hidden from normal viewing.
 - i. Required clearance dimensions.
- 3. Installation Ease:
 - a. Captive parts and captive hardware.
 - b. Provisions for leveling.
 - c. Through-wiring ease.
 - d. Securing and attachment to adjacent construction.
- 4. Maintenance:
 - a. Re-lamping ease.
 - b. Replacement of transformers, ballasts, lamp sockets, and other components or accessories.
- 5. Appearance:
 - a. Light Tightness.
 - b. Aesthetic appearance.
 - c. Scale.
- 6. Lamping:
 - a. Center Beam Candle Power (CBCP).
 - b. Color Rendering Index (CRI).
 - c. Color Temperature (°K).
 - d. Light Output, Mean and Initial Lumens.
 - e. Lamp Life, Rated Average Life (Hours).
 - f. Lamp Optics.
 - g. Physical Dimensions.
 - h. Physical Materials, including coatings and internal gas composition.
 - i. Type of Base.
 - j. Filament Design.
 - k. Voltage.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver lighting fixtures and lamping, individually wrapped in factory-fabricated containers unless otherwise noted.
- B. Handle lighting fixtures and lamping, carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures; replace and return damaged units to equipment Manufacturer.
- C. Store lighting fixtures, and lamping, in clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

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- D. All fixtures, lamping, accessories, and materials are to be effectively protected from damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work.

1.6 WARRANTY

- A. Ballasts and transformers shall be warranted for a minimum of three years, or that period offered by the ballast Manufacturer, whichever is greater. Replacement of faulty materials, and the cost of labor required to make the replacement shall be the responsibility of the Contractor.

1.7 EXTRA MATERIALS

- A. Precise extra materials requirements shall be determined in discussion with Owner's facility management group. At this time, the Subcontractor shall assume a 2% attic stock for fixtures exceeding 50 in quantity, and 4% for fixtures less than 50 in quantity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Manufacturer of each fixture type, and lamping, shall be as indicated on the Drawings and as specified below in article, Fixture Types. Refer to the requirements of paragraph, Approved Additional Manufacturers, for additional information.

2.2 MATERIALS AND FABRICATION

- A. Fixture fabrication and workmanship shall conform to the highest commercial standard as specified and indicated on the Drawings.
- B. Dissimilar metals used in fabrication must be separated to prevent galvanic action.
- C. Ferrous mounting hardware and accessories shall be finished using either a galvanic or phosphate primer backed paint process to prevent corrosion and discoloration of plaster surfaces.
- D. Hardware: For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be: stainless steel; cadmium; or equivalent. For stainless steel fixtures all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.
- E. Light Leaks: Fixtures shall be free of light leaks. Light leaks between trims of recessed fixtures and the surfaces they are mounted upon shall not be acceptable.
- F. Heat Dissipation: Fixtures shall be designed to provide sufficient heat dissipation and ventilation of lamps and ballasts including vent holes where required.
- G. Lamp holders (and Sockets): Lamp holders shall hold lamps securely against normal vibrations and maintenance handling. All lamp holders in lighting fixtures shall be suitable for the indicated lamps, and shall be set so that lamps are positioned in optically correct relation to all lighting fixture components. If adjustable socket positions are provided, socket should be preset in factory for lamp specified. If different socket positions are specified for the same fixture, sockets shall be preset for each type, and their cartons marked accordingly.
- H. Wiring channels and lamp holder mountings shall be rigid and accurately made.

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- I. Castings: For standard and custom fixtures made from castings, all castings shall be exact replicas of the approved casting patterns, and shall be free of sand pits, burrs, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings, in order that the finished castings will accurately fit in their designated locations.
- J. Reflector Cones:
1. Provide 45 degree lamp and lamp image cut-off unless otherwise specified.
 2. Plastic materials shall not be used for reflector cones, aperture plates, or other exposed components of the reflector assembly.
 3. Fixtures in which reflector cones are riveted or welded to housing or where removal of cone requires pressure to be applied to finished surface of reflector shall not be acceptable.
 4. Cone Flange: Cone flange shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The major flange surface shall be perpendicular to the cone axis. The width of the flange shall adequately cover the ceiling opening without light leaks. No fixture parts (housing, mounting frame, etc.) shall be visible between the ceiling surface and the edge of the cone flange.
 5. Reflector cones shall be manufactured of uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy free of spin marks or other manufacturing defects.
 6. The reflector inner surface finish shall be highly specular as produced under the Alzak process. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finish.
 7. Fixtures with Alzak reflector cones, unless otherwise specified, must be furnished by the same Manufacturer.
- K. In adjustable fixtures, positive locking and aiming devices for both pan and tilt of lamp shall be provided.
- L. Fixtures with an adjustable lamp and using a lamp with an asymmetrical light pattern shall have an aiming stop which can be permanently set so that the lamp shall remain correctly positioned after service or relamping.
- M. Lamping: Lamping for each type of fixture shall be as indicated on the drawings and as specified below in article, Fixture Types.
1. Any and all lamps banned under the United States Energy Policy Act of 1992 (EPACT), shall not be permitted for use on this project.
 2. Acceptable Manufacturers: Where no specific manufacturer is listed, acceptable manufacturers are as follows:
 - a. General Electric
 - b. Osram Sylvania
 - c. Philips Lighting
- N. Voltage: Voltages for each fixture type shall be as indicated on the electrical plans and schedules.
- O. Plenums: Lighting fixtures recessed in a hung ceiling where the space above the hung ceiling is used as a plenum chamber for either supply or return air for the air conditioning system shall be designed, manufactured, and wired to conform to local code requirements.
- P. Ballasts:
1. General

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- a. All ballasts shall exceed ANSI C82.11 limits for Total Harmonic Distortion (THD). No ballast shall have a THD exceeding 10%.
 - b. All ballasts shall meet FCC Part 18 (RFI & EMI) non-consumer standards for electrical equipment (Class A). Noisy or defective ballasts shall be replaced at no cost to the Owner.
 - c. All ballasts shall meet or exceed ANSI/IEEE 62.41 Category A standards for Transient Voltage Protection. They shall also be thermally protected with overload and short circuit protection with a Class P rating.
 - d. All ballast shall meet UL 935 standards and be UL Listed.
 - e. No ballast shall contain Polychlorinated Byphenols (PCB's) in accordance with US law.
 - f. Ballast shall meet all US state and federal efficacy laws.
 - g. All ballasts shall carry a five year warranty from the date of Manufacturer.
 - h. Wherever possible, electronic ballasts shall be used.
 - i. Lamp crest factor shall not exceed 1.7 for any ballast.
 - j. All ballasts shall contain an End-Of-Life (EOL) detection and shut down circuit in accordance with ANSI/IEC proposed standards.
 - k. Ballasts shall be suitable to operate in:
 - 1) In non-air-conditioned spaces: 10 to 65 degrees C. ambient.
 - 2) Outdoor applications: -18 to -29 degrees C ambient.
2. Fluorescent Ballasts:
- a. Ballasts shall be instant start or programmed rapid start ballasts, as specified in light fixture schedules, and from the same manufacturer for the entire project, unless otherwise specified. No preheat or trigger start ballasts shall be acceptable.
 - b. Ballasts shall operate between 108-132V (120V) and 249-305V (277V), whichever is applicable according to the electrical power distribution Drawings.
 - c. Ballast shall be able to withstand a voltage dip of up to 20% without affecting lamp output.
 - d. No ballast shall have a ballast factor of less than .90, unless specified otherwise.
 - e. All ballasts shall have a power factor greater than 90 percent (i.e. High Power Factor), and with maximum input watts not to exceed values indicated in fixture schedule.
3. Dimming Ballasts:
- a. For fixtures that require dimming ballasts, ballasts shall have a full continuous range of dimming from 100% to 1%.
 - b. Ballasts must be able to start lamp at any level without having to start at the high level first.
 - c. Ballast input wattage must be able to be reduced to less than 20% of nominal.
 - d. Ballast must be controlled via a forward phase cut-signal on the powerline.
 - e. All dimming ballasts shall be manufactured by the same company in order to assure consistent dimming across all lamp and fixture types.
4. HID Ballasts: For Metal Halide, High Pressure Sodium, Low Pressure Sodium and Mercury that cannot be controlled by an electronic ballast:
- a. Ballasts shall be magnetic core and coil constant wattage autotransformer.
 - b. 90% of operating voltage shall be obtained in seven minutes.
 - c. Ballast shall be able to withstand a voltage dip of up to 20% without affecting lamp output.
 - d. Ballasts shall have a ballast factor of one.
 - e. Ballast shall be rated for source and wattage intended lamp (e.g. a high pressure sodium ballast cannot be used with a metal halide lamp, etc.).
 - f. All HID ballasts shall have a dry film capacitor.
 - g. Ballasts shall have an "F" UL 1029 Bench Top Rise Temperature Code.
 - h. Ballasts shall operate between 108-132V (120V) and 249-305V (277V), whichever is applicable according to the electrical power distribution and Drawings.
5. Acceptable Ballast Manufacturers:
- a. Fluorescent Ballasts (Electronic):
 - 1) Lutron
 - 2) Osram
 - 3) Advance

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- b. Fluorescent Dimming Ballasts (Electronic):
 - 1) Lutron
 - 2) Osram
 - c. Fluorescent Dimming Ballasts (Digital):
 - 1) Lutron
 - 2) Osram
 - d. Metal Halide (Electronic):
 - 1) Aromat (NAIS)
 - e. HID that cannot be controlled by an electronic ballast including: Metal Halide; High Pressure Sodium; Low Pressure Sodium; and Mercury:
 - 1) Advance
 - 2) Universal Lighting Technologies
6. Remote Ballasts:
- a. Remote ballasts may not exceed distance recommended by the Manufacturer.
 - b. Remote ballasts must be located in existing access panels as indicated on the Architectural Drawings.
- Q. Transformers:
- 1. All transformers shall be electronic unless otherwise noted.
 - 2. Acceptable Magnetic Transformer Manufacturers:
 - a. Q-tran Inc.
 - b. Semper Fi
 - 3. Remote Transformers: All remote transformers shall be UL listed as a Low Voltage Lighting Power Supply Centers (PSC), and shall comply with N.E.C. Article 411. Where noted on the Drawings, specifications, or cut sheets, provide remote transformers as indicated herein.
 - 4. For all remote transformers: Provide Q-Tran Inc. Series, QT or QX Model, Remote Transformers/Power Centers, as recommended by Q-Tran, based on load and voltage drop considerations, unless otherwise indicated on the Drawings.
 - 5. All PSC shall have a minimum of 1-5 secondary circuit breakers ranging from 5A, 10A, 12.5A, 15A, 20A, to 25Amps.
 - 6. All remote transformers shall be magnetic toroidal transformers. Toroidal transformers shall have a thermal auto-reset breaker wound into the toroidal transformer.
 - 7. All remote transformers shall be Multi-Volt and have a minimum of 4 primary taps to provide either 12, 13, 14, 15V (or 24, 26, 28, 30V) at full load.
 - 8. Efficiency: Shall be 95% efficient minimum.
 - 9. Remote transformers shall have secondary circuit protection included into the Power Supply Center, maximum of 25Amps per N.E.C. article 411.
 - 10. Remote transformers shall have primary circuit protection.
 - 11. Remote transformers shall have Chokes.
 - 12. Remote transformers shall have terminal blocks for both primary and secondary terminations.
 - 13. Remote transformers shall have a separate wiring compartment from the transformer compartment.
 - 14. Remote transformers shall be UL Listed: Inherently Protected type IC for recess mounted into a 2X4 Stud wall with a zero clearance rating to combustible materials.
 - 15. Remote transformer enclosures shall be painted with white powder coat paint, unless noted otherwise.
 - 16. Manufacturer shall provide Voltage drop calculator to determine distance and wire gauge from the transformer to the load.
 - 17. Manufacturer shall offer remote transformer in 277V option (120V standard). Verify primary voltage with the Drawings.
 - 18. Transformer voltages: Transformer voltages and wattages shall be determined by the Architect.
 - 19. Transformer locations: Transformers must be located in existing access panels as shown on the Drawings.

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R. Cold Cathode:

1. System: Cold Cathode System to be high lumen 120ma mounted as shown on architectural detail Drawings, to form a continuous, seamless line of light in accordance with plans and specifications. System to include cathode lamps, ballasts, secondary cable, lamp holders and mounting hardware for cathode lamps.
2. Extrusion: The extrusion will be 2 parts (top and bottom) and shall be made of aluminum. The bottom extrusion shall have four .125 diameter holes for end plates to screw into, or for steel pins to be pressed into so that the adjacent fixture can be attached. The base extrusion can be used as a wire way. The top extrusion will be notched at the ends to allow the electrodes to pass thru, then the lamp and transformer will be mounted to the extrusion.
3. Lamp: Lamps shall be 25mm diameter, lead glass halophosphor or triphosphor coated as per specified color and fabricated to proper size, shape, and made with flat ends. The electrodes shall be rated for 200mA, and welded onto tube in a "bend back" configuration. The tube will then be heated and annealed to relieve stress and strengthen tube. Tubes will be processed with turbomolecor pump system and bombarded as per the electrode manufacturer.
4. Transformer: The transformer is a dimmable solid state type and is mounted inside the top extrusion. The transformer is UL2161 with the secondary fault detectors. The voltage will be 990 volts on the output and rated at 120mA. The secondary wire shall be listed GTO5 or greater and rated for 105C. Transformers have three wires that are Hot (120V), Dimmed Hot (0-120V), and Neutral (-). The transformer is High Power Factor for efficiency. Primary is 120volts/ .80 Amps each. A maximum of 14 fixtures per 20 Amp circuit is recommended.
5. Lens: (optional) The fixture will have a protective lens made of UV protected acrylic and will snap onto the sides of the extrusion. These lens are recognized by UL and have a flame class of 94HB.
6. Approval: The fixture must be tested by Underwriters Laboratories, Inc. (UL) as a complete unit and is listed for indoors and outdoors damp location. Each fixture will have a UL Listing Mark under UL File E216527. The fixture shall be tested under UL-48, UL-1598, and UL-5 Standards.
7. Manufacturer: These specifications are based the cold cathode systems of the Manufacturer noted below. Additional Manufacturers will be considered. The substitute system must meet all of the performance requirements noted in paragraph, Equality, and must be submitted for evaluation by the Architect in accordance with Section 01600, Product Requirements.
8. Submittal Drawings: Drawings shall be submitted by cold cathode manufacturer for approval. These drawings shall include scaled plans and details showing the location of ballasts, secondary feeds, lampholders and lamps.
9. Approved Manufacturers:
 - c. Cathode Lighting Systems
8020 Queenair Drive
Gaitherburg, Maryland 20879
Tel: 301-921-4120
Fax: 301-963-3050
<http://www.cathodelightingsystems.com>
 - d. Neotek
727 109th Street
Arlington, Texas 76011
Tel: 817 640 4300
Fax: 817 640 1177
<http://www.neoteklighting.com>

S. Fiber Optics:

1. General:
 - a. All edge-lit fiber shall be high luminance fully cured polymethacrylate.

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- b. All end-lit fiber shall be stranded PMMA jacketed in black PVC jacket.
 - c. Lengths shall be such that there is no visible luminance variation in the fiber.
 - d. Bend radius shall be eight times the diameter of the fiber.
 - e. Fiber shall be factory terminated. Edge-lit fiber shall be factory cut and polished and readied for installation into illuminator. End-lit fiber shall be factory harnessed including: randomization; crimping; fusing; and polishing, to maximize light acceptance of fiber. End-lit shall not be harnessed using only the typical hot knife method. Fixture end of end-lit fiber shall be factory terminated with a fixture ferrule glued to fiber using optically clear glue and polished to a smooth finish.
 - f. Fiber shall have visual, uniform color constancy over its length.
 - g. Fiber shall have an operating temperature between -20°C and 60° .
 - h. Fiber shall be flexible and resistant to fatigue, elongation and vibration.
 - i. Submit full shop drawings from the manufacturer with system layout for approval.
2. Fiber Optic Illuminator:
- a. General: The luminaire shall be a 75-watt halogen illuminator for illuminating fiber optic cables in permanent installations.
 - b. Mechanical Effects
 - 1) The luminaire shall provide subtractive CYM color mixing using gradated, dichroic glass, cyan, magenta, and yellow color filters.
 - 2) The intensity of the light shall be continuously adjustable by means of a mechanical dimmer that dims from 0 to 100% without loss of color temperature.
 - c. Housing:
 - 1) The luminaire shall have a plastic (Acrylonitrile Butadiene Styrene) housing.
 - 2) The housing shall be cooled with the aid of a filtered forced-air cooling system.
 - 3) The housing shall be weather-resistant, ingress protection class IP44.
 - d. Installation:
 - 1) The luminaire shall operate in any orientation when installed indoors, or horizontally in outdoor installations.
 - 2) The luminaire shall provide five 1/2 inch (13mm) holes for mounting hardware.
 - 3) The luminaire shall be mounted with clearances: from combustible materials; and around fan and air vents per the recommendations of the manufacturer.
 - e. Environmental: The luminaire shall operate in ventilated areas at temperatures not to exceed 40°C (104°F).
 - f. Electrical:
 - 1) The luminaire shall provide settings for operation on 50Hz and 60Hz supplies at 100, 120, 210, 230, and 250 volts.
 - 2) The luminaire shall be fitted with a 6 foot (1.8m) length of electrical cable for connection to AC power.
 - 3) The luminaire shall be electrically grounded.
 - 4) The luminaire shall be hardwired.
 - g. Physical Size: The maximum allowable dimensions of the luminaire shall be as follows:
 - 1) Length x Width x Height: 15.7 x 7.7 x 7.6 inches (398 x 195 x 192 mm).
 - 2) Weight: 17.6 lbs (8 kg).
3. End-Lit Fiber Optic Cable:
- a. Construction: Cable shall be concentrically laid, ultra-high purity PMMA, bundled in a black PVC jacket. Jacket shall be fire rated and have UV inhibitors, fungicides and algacides.
 - b. Jacket Fire Rating: VW1 Fire resistant.
 - c. Transmission Loss: Shall be less than 3% per meter.
 - d. Raw Fiber: Shall be 1.0mm PMMA fiber with a numerical aperture of 0.5.
 - e. Attenuation: Shall not be more than 180dB per Km at 650 nm (raw fiber).

T. LED Fixtures – White & Static Color

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1. All LED fixtures specified on the manufacturer's fixture cut sheets are to establish minimum performance criteria for each fittings application.
2. All LED fixtures will comply with the requirements of the following standards:
 - a. ANSI/NEMA/ANSLG C78.377-2008 – American National Standard for the Chromaticity of Solid State Lighting Products
 - b. LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products
 - c. LM-80-08, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
3. All LED fixtures on this project are subject to partial mock-ups as outlined in the architectural specifications.
4. All LED fixtures are subject to review by the Owner's Representative and written approval prior to installation.
5. Manufacturer of LED systems shall utilize an advanced production LED binning process to maintain color consistency. All LED individual fixture types must be shipped at the same time and stored on –site to ensure that products have been produced from the same bin. Tolerances greater the 200K will not be acceptable.
6. All white LED's shall be have a color temperature no higher than 3200K with a CRI no less than 80.
7. Efficacy of LED's should exceed 40 lumens per watt.
8. The LED fixtures shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.
9. High power LED fixtures shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, heat sinks and/or internal monitoring firmware. Junction temperature of LED shall not exceed LED chip manufacturer's recommendation.
10. LED fixture housings shall be designed to transfer heat from the LED board to the outside environment.
11. Where applicable, for wet location use, LED-based fixture itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure.
12. All hardwired connections to LED fixtures shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
13. Fixtures used on the exterior building facades shall have a minimum IP56 rating. All LED fixtures and power/data supplies shall be provided by a single manufacturer to ensure compatibility.
14. All products associated with installation and control of the LED system, including peripheral devices and software are to be provided by a single manufacturer.
15. Power/data supply shall provide mis-wiring protection.
16. Power/data supply shall provide connections that are conduit-ready or clamp-style connections for the low-voltage wiring.
17. Power/data supply shall come with a housing that meets a minimum IP20 rating for dry location installation.
18. All LED fixtures (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing.
19. All LEDs used in the LED fixture shall be high brightness and proven quality from established and reputable LED manufacturers in business for greater than 5 years.
20. All power/data supplies shall be located on the interior of the buildings and shall not be exposed to the elements.
21. LED fixtures shall be UL/ETL Listed.
22. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

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23. Manufacturer shall provide photometric data in IES file format in accordance with IES LM-63-2002, based on test results from an independent testing lab upon request.
24. Manufacturer shall provide optical performance, polar diagrams, and relevant luminance and illuminance photometric data based on test results from an independent testing lab.
25. Manufacturer shall provide installation guides.
26. Manufacturer shall provide system wiring diagrams.
27. Manufacturer shall provide a factory-trained applications engineer for on-site supervision of start-up upon request.
28. White LED sources must meet the following requirements:
 - a. Luminaires must be rated for -40°C to +50°C operation
 - b. Correlated Color Temperature (CCT) shall be one of the following, as selected by Owner:
 - 1) Nominal CCT: 2700 K (2725 ± 50)
 - 2) Nominal CCT: 3000 K (3045 ± 50)
 - 3) Nominal CCT: 3500 K (3465 ± 50)
 - 4) Nominal CCT: 4000 K (3985 ± 50)
 - 5) Nominal CCT: 4500 K (4503 ± 50)
 - 6) Nominal CCT: 5000 K (5028 ± 50)
 - 7) Nominal CCT: 5700 K (5665 ± 50)
 - 8) Nominal CCT: 6500 K (6530 ± 50)
 - c. DUV tolerance of 0.001 ± 0.006
 - d. Color Rendering Index (CRI): ≥ 80
 - e. Luminaire manufacturer must submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows:
 - 1) High Temperature Operating Life (HTOL)
 - 2) Room Temperature Operating Life (RTOL)
 - 3) Low Temperature Operating Life (LTOL)
 - 4) Powered Temperature Cycle (PTMCL)
 - 5) Non-Operating Thermal Shock (TMSK)
 - 6) Mechanical shock
 - 7) Variable vibration frequency
 - 8) Solder Heat Resistance (SHR)
29. Acceptable LED chip manufacturers:
 - a. Osram
 - b. Philips - LumiLEDs
 - c. Nichia
 - d. Cree
 - e. Seoul Semi-Conductor
 - f. Xicato
 - g. Bridgelux
30. Acceptable fixture manufacturers or approved equal:
 - a. Subject to written approval.

U. LED Fixtures –Dynamic Color Changing

1. With the exception of color temperature requirements, all dynamic color changing LED fittings shall follow the requirements outlined under Section 2.02, subsection T of this specification.
2. The LED system shall be capable of at least 8-bit control of red, green and blue LEDs to produce 16.7 million colors or more.
3. The LED system shall be digitally driven using high-speed pulse width modulation (PWM).
4. The LED system shall be digitally driven using noise shaping pulse width modulation (PWM) techniques.
5. The LED system shall use integral and differential nonlinear control.

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6. The LED system shall use 14-bit or greater nonlinear scaling techniques for high-resolution output.
 7. Constant data transmission rates shall be employed, resulting in the output being independent of distance of cable between power supply and light source within the specified length.
 8. Power/data supply shall provide connections that are conduit-ready or clamp-style connections for the low-voltage wiring.
 9. Power/data supply shall come with a housing that meets a minimum IP20 rating for dry location installation.
 10. Power/data supply shall have power factor correction.
 11. LED system shall have a selectable means of external control via a data network.
 12. Each LED fitting and/or node shall have the capability to be set to a unique and individual digital address. Address shall be by an external software method.
 13. The LED system shall be scalable, with every LED fitting/address in the system capable of being controlled by a single, centralized controller.
 14. The LED system shall support frame rates greater than 30 frames per second.
 15. Manufacturer shall provide mechanical, electrical, network communication and environmental specifications.
 16. Manufacturer shall provide a factory-trained applications engineer for on-site supervision of startup and programming.
 17. Manufacturer shall grant a license for use of relevant patents with the purchase of the patented LED lighting system.
 18. Manufacturer shall be able provide a reference listing of at least 150 installations world-wide using its intelligent LED-based systems.
- V. Custom Fixtures: Provide complete custom fixture assemblies as indicated on architectural drawings and as indicated herein.
1. Metal Work: Provide all metal work for custom fixtures in accordance with the quality and standards specified in Section, Ornamental Metal. Coordinate shop drawings for custom fixtures with that of adjacent trades for mounting of fixtures.
- W. Instructions: Each lighting fixture shall be packaged with complete installation instructions and illustrations.

2.3 FIXTURE TYPES

- A. General: Fixture types, quantities, etc., are described in this Specification, shown on the Drawings and delineated by the details.
- B. Fixture Designation: Each fixture type is designated by a letter or alphanumeric symbol as indicated on the Drawings, and as described herein.
- C. Fixture Type Schedule: All specific information regarding each fixture type is provided in Architectural Fixture Cut Sheets, Section 16502 (to be included at a future date). The Lighting Fixture Schedule, Section 16503 indicates manufacturer, fixture description, lamp code, remarks and approved alternate fixture manufacturers.

PART 3 - EXECUTION

3.1 EXAMINATION

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- A. Verification of Conditions: Examine the areas to receive Work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide all mounting hardware and accessories as required for ceiling construction type indicated on the plans and schedules. Fixture catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a fixture may be installed.
- B. Provide adequate and sturdy support for each lighting fixture, as shown on the detail Drawings. Provide all appurtenances required for the proper, safe and distortion-free installation of all fixtures in the various surfaces in which they appear. Determine surface types from the Drawings.
- C. Install lighting fixtures in strict accordance with the Manufacturer's recommendations and instructions.
- D. Install fixtures with vent holes free of air blocking obstacles.
- E. Install pendant fixtures plumb, and at a height above the floor, as specified on the Drawings.
- F. Fixtures shall be carefully aligned, leveled in straight lines, and located as shown on the architectural reflected ceiling plan. The final decision as to adequacy of support and alignment, shall be given by the Architect.
- G. Recessed fixtures shall have trims which fit neatly and tightly to the surfaces in which they are installed without leaks or gaps.
- H. All fixtures, once lamped and tested, shall remain off for the duration of construction. Fixtures shall not be used as construction work lights by the Contractor for any duration of time. If there is evidence to the contrary then at the discretion of the Architect, all fixtures shall be re-lamped with new lamps at the conclusion of construction, at no additional cost to the Owner.
- I. Do not install fixture parts such as: finishing plates; trims; reflector cones; baffles; aperture plates; light controlling elements for air-handling fixtures; or decorative elements, until after plastering, painting, completions of ceiling tiles, other work that may mar fixtures, and general cleanup, has been completed.
- J. Fixtures shall be left clean at the time of acceptance of the work with every lamp in operation. If fixtures are deemed dirty by the Architect at completion of the project, the Contractor shall clean them at no additional cost to the Owner.
- K. Fixtures shall be aimed or installed to provide the lighting pattern for which the fixture is designed.

3.3 LOCATION

- A. Locations of fixtures are shown diagrammatically. Verify exact quantities, location and spacing with the Drawings and other reference data before ordering of fixtures and during installation.
- B. Notify Architect about field conditions at variance with Contract Documents before commencing installation.
- C. Coordinate space conditions with all other applicable trades before ordering of fixtures.

3.4 WIRING

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- A. See Drawings and specifications for exact wiring requirements for all fixture types.
- B. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute through circuit wiring), must be suitable for temperature, current, and voltage conditions to which it is subjected.
- C. Splices in internal wiring, shall be made in accordance with the requirements of the specifications, suitable for the temperature and voltage conditions to which they are subjected.

3.5 ANCHORAGE TO STRUCTURE

- A. Steel Structural Members: Anchor with "C" form flange clamps.
- B. Concrete Structure: Type of anchorage to be reviewed for appropriateness by the Architect.
- C. Suspended Plaster or GWB Ceilings: Anchor to main channel runners.
- D. Support all fixtures independently of duct-work or piping.

3.6 AIMING, ADJUSTMENT AND PUNCH LISTING

- A. Aiming and Adjustment: Provide labor and materials for final aiming and focusing of all adjustable fixtures under the Architect's supervision. All aiming and adjusting shall be carried out, after the entire installation is complete, unless otherwise approved by the architect due to construction scheduling. The Contractor shall provide the personnel and equipment for this task, in accordance with all applicable union agreements. All aiming and adjusting shall be per the

direction of the Architect. As aiming and adjusting is completed, locking set screw, and nuts and bolts shall be tightened securely.
- B. Night Work: Where possible, fixtures shall be focused during the normal working day; however, where daylight interferes with: aiming; or the ability of the Architect to ascertain illumination levels; aiming shall be accomplished at night, at no additional cost to the Owner.
- C. Punch Listing: During aiming and focusing the Architect shall punch list the work.
- D. Timing: Aiming and adjusting shall be appropriately scheduled by the Contractor, so as to allow for sufficient time to correct punch list items observed, and if necessary additional aiming and adjusting, prior to occupancy by the Owner.

3.7 EXECUTION SPECIFIC TO THEATRICAL PULLDOWNS

- A. All theatrical pulldowns must be tied back to structure.
- B. At the time of commissioning, theatrical pulldowns shall be pulled down, locked in place with a 4'-0" mounting bar inserted into the fixture.
- C. Theatrical pulldown stage-pin circuits shall be labeled per control intent shown on drawings. Edison circuits do not have to be labeled, but shall be electrified at all times.

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- D. During the commissioning phase, the contractor must be able to visually demonstrate that all theatrical pulldowns are functioning using a test lamp for each circuit. Test lamps shall be installed in fixtures at time of Lighting Designer's commissioning visit.

3.8 EXECUTION SPECIFIC TO FIBER OPTIC LIGHTING SYSTEMS

A. Contractor Responsibilities:

1. Verify mounting locations for all illuminators and that manufacturer's ventilation requirements are met.
2. Verify installation of appropriate power service at location of all illuminators.
3. Verify exact lengths of cables.
4. Verify exact locations of end-lit fixtures.
5. Verify exact lengths of all fiber optic cable tails, their associated illuminators and fixtures.
6. Verify space behind fixtures allows for required fiber optic cable bending radius.
7. Install illuminators, fixture fittings and pre-assembled fiber optic cable harnesses per manufacturer's recommendations.

B. Manufacturer's Services:

1. Provide detailed submittal package per specifications.
2. Pre-terminate all fiber optic cables into appropriate harness adapter per specifications.
3. When required, provide detailed as-built documentation in the form of an updated submittal package.

3.9 MANUFACTURER'S SERVICES, COLOR CHANGING LED FIXTURES

- A. A factory-employed engineer shall make a minimum of two site visits to ensure proper system installation and operation. The first visit shall consist of a system formal check-out; upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer, including programming the LED control system. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. During the second visit, a factory-employed engineer shall: demonstrate and educate the Owner's representative(s) on the system capabilities, operation, programming, and maintenance; and meet with the Architect during aiming of lighting, at a time to be coordinated by the Contractor. Training of Owner's representatives shall not exceed four working hours. Additional training shall be available upon request.
- B. The factory representative shall be responsible for addressing all fixtures and shall provide programming services for up to 12 presets.
- C. Upon completion of the installation, including testing of system, the contractor shall notify the LED Fixture Manufacturer that the system is available for formal checkout.
- D. Notification shall be provided in writing, two weeks prior to the time factory-trained personnel are needed on the job site.
- E. No power is to be applied to the LED system unless specifically authorized by written instructions from the manufacturer.

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- F. The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.

3.10 CLEANUP

- A. At the time of final acceptance by the Owner all lighting fixtures shall have been thoroughly cleaned with materials and methods as recommended by the Manufacturer; all broken parts shall have been replaced; and all lamps shall be operative.

END OF SECTION 26 51 01

SECTION 26 51 02 – ARCHITECTURAL LIGHT FIXTURE CUT SHEETS

Type	Issue Date
INTERIOR FIXTURES	
S101	October 20, 2023
S102A	Removed April 8, 2024
S102B	Removed April 8, 2024
S103A	February 19, 2024
S103B	February 19, 2024
S104A	October 20, 2023
S104B	October 20, 2023
S105	October 20, 2023
S105A	February 19, 2024
S106	February 19, 2024
S107	October 20, 2023
S108	February 19, 2024
S109	October 20, 2023
S109A	October 20, 2023
S110	February 19, 2024
S111	Removed April 8, 2024
S111A	Removed February 19, 2024
S112	February 19, 2024
S113	February 19, 2024
S114	October 20, 2023

SECTION 26 51 02 – ARCHITECTURAL LIGHT FIXTURE CUT SHEETS

Type	Issue Date
S114_TRACK	October 20, 2023
S115	February 19, 2024
S116	February 19, 2024
S117	February 19, 2024
S118	February 19, 2024
S119	April 8, 2024
S120	April 8, 2024
S121	April 8, 2024
EXTERIOR FIXTURES	
S201	February 19, 2024
S202	February 19, 2024
S203	October 20, 2023
S204	October 20, 2023

END OF SECTION 26 51 02

SECTION 26 51 02 – ARCHITECTURAL LIGHT FIXTURE CUT SHEETS

SECTION 26 51 03 - ARCHITECTURAL LIGHTING CONTROLS

SECTION 26 51 03 - ARCHITECTURAL LIGHTING DIMMING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Central dimming control systems.
- B. Related Sections:
 - 1. Section 265001
 - 2. Section 265002

1.2 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org)
 - 1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- B. ASTM International (ASTM) (www.astm.org)
 - 1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
- C. Canadian Standards Association (CSA) (www.csa.ca)
 - 1. CSA C22.2 # 14 Industrial Control Equipment
 - 2. CSA C22.2 # 184 Solid-State Lighting Controls
 - 3. CSA C22.2 # 156 Solid-State Speed Controls
- D. International Electrotechnical Commission (www.iec.ch)
 - 1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
 - 2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- E. International Organization for Standardization (ISO)
 - 1. 9001:2000 – Quality Management Systems.
- F. National Electrical Manufacturers Association (NEMA)
 - 1. WD1 (R2005) - General Color Requirements for Wiring Devices.
- G. Underwriters Laboratories, Inc. (UL)www.ul.com
 - 1. 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 2. 508 (1999) - Standard for Industrial Control Equipment.

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3. 1472 (1996) - Solid-State Dimming Controls. UL 924 is the UL Standard for Safety for Emergency Lighting and Power Equipment ensures that the lighting system will meet safety requirements in emergency situations.
4. 924 (2003) - Emergency Lighting and Power Equipment
- H. Federal Communications Commission (FCC) rules – Part 15 (Class B): Radio Frequency Devices
- I. California Energy Commission (CEC) – Title 24

1.3 SYSTEM DESCRIPTION

- A. Modular dimming control: Factory assembled dimming control, interfaces, and modules. Low voltage wall stations, control interfaces, and sensors.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Specification Conformance Document: Indicate whether the submitted equipment:
 1. Meets specification exactly as stated.
 2. Meets specification via an alternate means and indicate the specific methodology used.
- C. Shop Drawings; include:
 1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
 2. Schematic of system.
- D. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Provide Operation and Maintenance Manuals:
 1. Including:
 - a. Warranty Information
 - b. System Start-up Information
 - c. Installation Guide
 - d. Set-up and Programming Guide
 2. Electronic format to be available on Lighting Control System manufacturer website.
- B. Sustainable Design Closeout Documentation

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1. Lighting Control System Manufacturer to provide Enhanced Start-up documentation that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years experience in manufacture of architectural lighting controls.
- B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- C. Central dimming control system:
 1. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
 2. Relative humidity: Maximum 90 percent, non-condensing.
 3. Lighting control system must be protected from dust during installation.

1.8 WARRANTY

- A. Provide Manufacturer's Warranty:
 1. Minimum 5-year limited parts warranty, Includes:
 - a. Years 1-2:
 - 1) 100 Percent Replacement Parts for Manufacturer Lighting System Components
 - 2) 100 Percent Manufacturer Labor Coverage to Troubleshoot and Diagnose a Lighting Issue
 - 3) First-Available Onsite or Remote Response Time
 - 4) Remote Diagnostics for Applicable Systems
 - b. Years 3-5: 50% Replacement Parts Coverage
 - c. 24 Hours Per Day, 7 Days Per Week Telephone Technical Support, Excluding Manufacturer Holidays



- B. Provide Manufacturer's Technology Support Plan for 5 years covering 100 percent parts and 100 percent Manufacturer labor and additional benefits as described below beginning 2 years

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after system startup completion.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.
- B. Make new replacement parts available for minimum of 10 years from date of manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: ETC – System: Paradigm
- B. Basis of design product: ETC Paradigm or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - 1. ETC
 - 2. Elation
 - 3. Altman
- C. Substitutions: Under provisions of Division 1.
 - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
 - 2. Any substitutions provided by the contractor shall be reviewed at the contractor's expense by the electrical engineer at a rate of \$200.00 per hour.
 - 3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 GENERAL

- A. Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C

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- C. (104 degrees F) and 90 percent non-condensing relative humidity.
- D. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
- E. Wireless Devices shall:
 - 1. Have addresses automatically assigned to them.
 - 2. Receive signals from other wireless devices and provide feedback to user.
 - 3. Work in conjunction with wireless occupancy sensors, wireless vacancy sensors, and wireless controllers.
 - 4. Use proprietary Radio Frequency (RF) protocol.
 - 5. Use RF communication in compliance with FCC Part 15.231.

2.3 DIMMING PERFORMANCE REQUIREMENTS

- A. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
- B. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): Manufacturer's maximum current rating minimum two times control's rated operating current.
- C. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer.
- D. Design and test dimmers to withstand line-side surges without impairment to performance.
 - 1. Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41.
 - 2. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
- E. Utilize air gap off – activated when user selects “off” at any control to disconnect the load from line supply.
- F. Power failure memory and dimmer/relay recovery:
 - 1. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
- G. Multiple load type, tested to UL 508 to specifically control incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, digital fluorescent dimming ballasts, fluorescent dimming ballasts, and non-dim loads.
- H. Each dimmer to be assigned a load type that will provide a proper dimming curve for the

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specific light source.

- I. Possess ability to have load types assigned per circuit, configured in field.
- J. Minimum and maximum light levels user adjustable on circuit-by-circuit basis.
- K. Control all light sources in smooth and continuous manor. Dimmers with visible steps are not acceptable.
- L. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment to meet these requirements.
- M. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
- N. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
- O. Line Voltage Dimmers; Meet following load-specific requirements:
 1. Magnetic Low Voltage (MLV) transformer:
 - a. Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
 - b. Dimmers using back-to-back SCR construction that could fail open causing DC power to flow into magnetic low voltage load are not acceptable.
 2. Electronic Low Voltage (ELV) transformer:Dimmer to operate electronic low voltage transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
 3. Neon and cold cathode transformers:
 - a. Magnetic transformers: UL listed for use with normal (low) power factor magnetic transformers.Electronic transformers: Must be supported by the transformer equipment manufacturer for control of specific transformers being provided.
 4. Fluorescent electronic dimming ballast
- P. Direct low-voltage control of digital ballasts (120V, 220/240V, and/or 277V lighting):
 1. Electronically link a digital fluorescent lighting ballast to a zone for both dimming and turn on/off
 2. Energy usage and light level status visible to operator on an integral display
 3. Electronically assign occupancy sensors for manual on/auto off and auto on/auto off
 4. Electronically assign daylight sensors to digital ballasts and line voltage dimmers for proportional daylight harvesting
 5. Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct (no-interface) control.

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- Q. Low Voltage Dimming Interface; Meet following requirements:
 - 1. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.
 - 2. Single low voltage dimming module; capable of controlling following light sources:
 - a. 0-10V analog voltage signal.
 - 1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - 2) Sink current via IEC 60929.

2.4 POWER INTERFACES

- A. Provide power interfaces required as defined on project drawings: [PHPM-PA-DV], [PHPM-PA-120], [PHPM-3F-DV], [PHPM-3F-120], [PHPM-SW-DV], [GRX-TVI]
- B. Electrical:
 - 1. Phase independent of control input.
 - 2. Dimmer to meet limited short circuit test as defined in UL 20.
- C. Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

2.5 WALL STATIONS

- A. Line Voltage Control Unit:
 - 1. Preset lighting control with zone override:
 - a. Intensity for each zone indicated by means of one illuminated bar graph per zone.
 - b. Each zone and scene to be field customizable to indicate each zone and scene name.
 - c. Astronomical time clock and programmer interface
 - 1) Provide access to:
 - a) Scene selections.
 - b) Fade zone to a level.
 - c) Fine-tuning of preset levels with scene raise/lower.
 - d) Lock out scenes and zones.
 - e) Fine-tuning of light levels with individual zone raise/lower.
 - f) Terminal block for wired infrared signal input.
 - g) Enable/disable wall station.
 - d. Light intensity with real time energy savings by digital display.
 - e. Fade time indicated by digital display for current scene while fading.
 - f. Incorporate built-in wide angle infrared receiver.
 - g. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
 - h. Preset expandable shade control: Provide up to 3 columns of shade control.
 - 1) For temporary local overrides, individual raise/lower buttons to allow zones to

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- be adjusted without altering scene values stored in memory.]
- i. Direct low-voltage control of digital ballasts (120V, 220/240V, and/or 277V lighting).
 - j. Wireless integration with occupancy/vacancy sensors, wireless controller, shades and other wireless control units by same manufacturer.
2. Color:
- a. Custom color to be selected.
 - b. Color variation in same product family: Maximum $\Delta E=1$, CIE L^*a^*b color units.
 - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
- B. Architectural Low Voltage Wall Stations:
1. Electronics: The following statement provides for reliable wired communication.
 - a. Use RS485 wiring for low voltage communication.
 2. Functionality:
 - a. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.
 - b. Allow for easy reprogramming without replacing unit.
 3. Provide faceplates with concealed mounting hardware.
 4. Color:
 - a. Custom color to be selected.
 - b. Color variation in same product family: Maximum $\Delta E=1$, CIE L^*a^*b color units.
 - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
- C. Designer Low Voltage Wall Stations
1. General:
 - a. Class 2 (low voltage).
 - b. Integral IR receiver for personal control.
 - c. Wall stations can be replaced without reprogramming.
 - d. Color:
 - 1) Match NEMA WD1, Section 2 White.
 - 2) Color variation in same product family: Maximum $\Delta E=1$, CIE L^*a^*b color units.
 - 3) Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
 2. One Button Control
 - a. Toggle on/off and master raise/lower control for group of fixtures.
 3. Four Button Control
 - a. Recall 4 Scenes plus all on or all off for one group of fixtures.
 - b. Master raise/lower control entire group of fixtures.
- D. Provide faceplates with concealed mounting hardware.

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- E. Engrave wall stations in English with appropriate button, zone, and scene engraving descriptions furnished prior to fabrication. Engraving must be durable when exposed to cleaning, and normal wear.
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- F. Silk-screened borders, logos, and graduations to use graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.

2.6 LIGHTING CONTROL MODULE

- A. Relay Lighting Control Module:
 - 1. Mechanical:
 - a. Listed to UL 508 (United States) as industrial control equipment.
 - b. Delivered and installed as a UL listed factory assembled panel.
 - c. Panels passively cooled via free-convection, unaided by fans or other means.
 - 2. Surface mounted
 - 3. Switching:
 - a. Rated life of relay: Minimum 1,000,000 cycles.
 - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - d. Module to integrate up to 4 individually controlled zones, each with a capacity of up to 16 amps, of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads).
 - 4. Connection without interface to wired:
 - a. Occupancy sensors
 - b. Daylight sensors
 - c. IR receivers for personal control
 - 5. Connects to Lighting Management Panel via RS485.
 - 6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
 - 7. Thermal protection reports to Light Management System if module overheats.
 - 8. Contact Closure Input
 - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
 - 1) Activate scenes
 - 2) Enable or disable timeclock
 - 9. Emergency Contact Closure Input
 - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system
 - b. Allow configurable zone response during emergency state.

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- c. Disable control operation until emergency signal is cleared.

B. 0-10V Lighting Control Module:

1. Meet the following requirements:
 - a. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.
 - b. Single low voltage dimming module; capable of controlling following light sources:
 - 1) 0-10V analog voltage signal.
 - a) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - b) Sink current via IEC 60929.
2. Mechanical:
 - a. Listed to UL 508 (United States) as industrial control equipment. CSA (Canada) certified, or NOM (Mexico) approved as applicable.
 - b. Delivered and installed as a [UL] [CSA] listed factory assembled panel.
 - c. Panels passively cooled via free-convection, unaided by fans or other means.
3. Surface mounted
4. Switching:
 - a. Rated life of relay: Minimum 1,000,000 cycles.
 - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - d. Module to integrate up to 4 individually controlled zones, each with a capacity of up to 16 amps, of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads).
5. Connection without interface to wired:
 - a. Occupancy sensors
 - b. Daylight sensors
 - c. IR receivers for personal control
6. Connects to Lighting Management Panel via RS485.
7. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
8. Thermal protection reports to Light Management System if module overheats.
9. Contact Closure Input
 - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
 - 1) Activate scenes
 - 2) Enable or disable timeclock
10. Emergency Contact Closure Input
 - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system
 - b. Allow configurable zone response during emergency state.
 - c. Disable control operation until emergency signal is cleared.

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- C. Digital Fixture Lighting Control Module
 - 1. Mechanical:
 - a. Listed to UL 508 (United States) as industrial control equipment
 - b. To acquire UL or CSA listing on field assembled panels, a UL/CSA inspector must test the installed equipment on site. This will add costs to the project and could
 - c. result in delays. Factory assembled panels are fully tested and UL/CSA listed when delivered to the site. These pre-assembled panels can be quickly installed and eliminate potential assembly errors in the field, saving installation costs.
 - d. Delivered and installed as a UL listed factory assembled panel.
 - e. Panels passively cooled via free-convection, unaided by fans or other means.
 - 2. Supports one or two independent links of up to 64 ballasts per link.
 - 3. Connect without interface to wired:
 - a. Occupancy sensors
 - b. Daylight sensors
 - c. IR receivers for personal control
 - 4. Connects to Lighting Management Panel via RS485.
 - 5. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
 - 6. Thermal protection reports to Light Management System if module overheats.
 - 7. Contact Closure Input
 - a. Directly accept contact closure input from a dry contact closure or solid-state output without interface to:
 - 1) Activate afterhours mode
 - 2) Provide basic load shed functionality
 - 8. Emergency Contact Closure Input
 - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 Listed Emergency Lighting Interface, security system or fire alarm system
 - b. Disable control operation until emergency signal is cleared.
 - 9. Programming Connection:
 - a. Provide Ethernet input for wired connection to wireless router.
 - b. Provide ability for programming from an iPod touch or iPhone via wireless router.

2.7 LOW VOLTAGE CONTROL INTERFACES

- A. Contact Closure Interface:
 - 1. The contact closure input device will accept both momentary and maintained contact closures.
 - 2. The contact closure output device can be configured for maintained or pulsed outputs.
- B. Contact Closure Input Interface:
 - 1. The contact closure input device will accept both momentary and maintained contact closures.

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C. Ethernet Interfaces:

1. Provide ability to communicate by means of
 - a. TCP/IP over Ethernet to GRAFIK Eye QS system by means of user-supplied PC or digital audiovisual equipment. Control to be located within 300 feet (100 meters) of Ethernet source.
 - b. RS232 serial communication to GRAFIK Eye QS series system by means of user-supplied PC or digital audiovisual equipment. Control to be located within 50 feet (15 meters) of RS232 source.
2. Provide access to:
 - a. Scene selections.
 - b. Fade zone to a level.
 - c. Set level of shade(s).
 - d. Fine-tuning of preset levels with scene raise/lower.
 - e. Lock out scenes and zones.
 - f. Fine-tuning of light levels with individual zone raise/lower.
 - g. Fine-tuning of shade levels with individual zone raise/lower.
 - h. Enable/disable wall station.
3. Provide status monitoring through button feedback and scene-status updates.

D. DMX Interface

1. Provide ability to:
 - a. Map a single zone intensity from a control unit to a single DMX512 channel
 - b. Map a single zone intensity from a control unit to 3 DMX512 channels for RGB/CMY color-control

E. Sensor Module:

1. Provide wired inputs for:
 - a. Occupancy sensors
 - b. Daylight sensors
 - c. IR receivers for personal control
 - d. Digital Ballast Wall Stations
2. Wireless Integration
 - a. Provide wireless communication inputs for:
 - 1) Occupancy sensors
 - 2) Daylight sensors
 - 3) Wireless Controller
 - b. Provide RF range of 18 meters (60 feet) line of sight or 9 meters (30 feet) through walls.
 - c. RF frequency of [434 MHz] [868 MHz]
3. Communicate sensor information to wired device for use by compatible devices.

2.8 ECOSYSTEM DIMMING BALLAST AND SWITCHING MODULES

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A. General

1. Continuous 3-Wire signal dimming to electronic dimming ballast.
2. Connect without interface to:
 - a. Occupant sensor (motion detector).
 - b. Daylight sensor.
 - c. Personal control input (wall station or infrared receiver).
3. Generate digital communication commands to distribute ballast and sensor data on the digital bus.
4. If power is interrupted and subsequently returned, lights automatically return to the setting prior to power interruption.
5. Each ballast responds independently to:
 - a. Up to 32 occupant sensors.
 - b. Up to 64 personal control inputs.
 - c. 2 daylight sensors.
6. Unique internal reference number visibly displayed on module cover.
7. Averages 2 independent daylight harvesting inputs internally.
8. Responds to digital load shed command
 - a. Sets high end trim.
 - b. Automatically scales light output proportional to load shed command.
 - 1) Example: If light output is at 30 percent and a load shed command of 10 percent is received, the ballast automatically sets the maximum light output at 90 percent and lowers current light output by 3 percent to 27 percent.
9. Electrical: Dimmer to meet limited short circuit test as defined in UL 20.
10. Provide integral fault protection to prevent ballast module failure in the event of a mis-wire.

B. 2 Amp (BMF) 3-Wire Ballast Module

1. Ballast module to integrate up to 2 amps of 3-wire electronic dimming ballast into an EcoSystem control system as a single zone.

C. 16 Amp (BMJ) 3-Wire Ballast Module

1. Ballast module to integrate up to 16 amps of 3-wire electronic dimming ballast into an EcoSystem control system as a single zone.

D. 16 amp (XPJ) Switching Ballast Module

1. Module to integrate up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into an EcoSystem control system as a single zone.

2.9 SENSORS

A. Wireless Ceiling Occupancy/Vacancy Sensors

1. Wireless Ceiling Sensors shall:
 - a. Have an operational lifetime of 10 years without the need to replace batteries when

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- installed per manufacturer's instructions.
 - b. Communicate directly to compatible RF receiving devices through use of a radio frequency communications link.
 - c. Not require external power packs, power wiring, or communication wiring.
 - d. Provide a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
 - e. Have a multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 - f. Utilize Infrared as its sensing mechanism. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
 - g. Have optional, readily accessible, user adjustable controls for timeout, automatic/manual-on, and sensitivity.
 - h. Have the ability to be placed in test mode to verify correct coverage and operation from the face of the unit.
 - i. Have a radio frequency range of up to 60' (18.3 m) between sensor and compatible RF receiving device(s).
 - j. Turn off lighting automatically after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area.
 - k. Comply with the limits for a Class B device, pursuant to part 15 of the FCC rules.
 - l. Communicate with up to 10 compatible RF receiving devices.
2. Mounting:
- a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, compressed fiber ceilings.
 - b. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - c. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method shall be designed for easy, damage-free removal.
 - d. Ceiling-mount wireless occupancy/vacancy sensors using passive infrared technology shall have a customizable mask to block off unwanted viewing areas.
 - e. Sensor lens shall illuminate during test mode when motion is detected to allow installer to verify coverage prior to permanent mounting.
3. Wireless occupancy/vacancy sensor can be programmed to operate as an occupancy sensor (automatic-on and automatic-off functionality), an occupancy sensor with low light feature (automatic-on when less than 1 fc (10 lux) of ambient light available and automatic-off functionality), or a vacancy sensor (manual-on and automatic-off functionality).
4. A vacancy-only model shall be available to meet California Title 24 Energy Efficiency Standard requirements.

B. Wired Ceiling and Wall Mount Occupancy/Vacancy Sensors

- 1. Sensing mechanism:
 - a. [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

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- b. [Ultrasonic]: Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.

- c. [Dual technology]:

- 1) Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
 - 2) Utilize an operating frequency of 32kHz or 40kHz that shall be crystal controlled to operate within plus or minus 0.005 percent tolerance.
2. Connect directly to digital ballast and modules without the need of a power pack or other interface
 3. Sensors shall turn off or reduce lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space
 4. Sensor shall accommodate all conditions of space utilization and all irregular work hours and habits.
 5. Sensors shall be [UL], [CUL], [NOM] listed (as appropriate)
 6. Sensors shall be fully adaptive and adjust their sensitivity and timing to ensure optimal lighting control for any use of the space
 7. Sensors shall have field adjustable controls for time delay and sensitivity to override any adaptive features.
 8. Power failure memory:
 - a. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and learned parameters saved in protected memory shall not be lost.
 9. Provide all necessary mounting hardware and instructions.
 10. Sensors shall be Class 2 devices.
 11. Indicate viewing directions on mounting bracket for all Ceiling mount sensors.
 12. Provide customizable mask to block off unwanted viewing areas for all ceiling mounted sensors using infrared technology.
 13. Provide swivel mount base for all wall mount sensors.
 14. [Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.]

C. Sensor Power Packs

1. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
2. For ease of mounting, installation and future service, power pack(s) shall be able to mount through a 1/2" knock-out in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a minimum of three (3) sensors.
3. Power pack shall be plenum rated

D. Infrared Receivers

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1. Use Class 2 wiring for low voltage communication
 2. Can be replaced without reprogramming
 3. 360 degree reception of wireless infrared remote controls
 4. Immediate local LED response upon reception of hand held transmitter communication

 5. Constructed with plastic meeting UL94 HB
 6. Mountable on lighting fixtures or recessed acoustical ceiling tiles
 7. Constructed via sonic welding
 8. Color:
 - a. Match NEMA WD1, Section 2 White
 - b. Color variation in same product family: Maximum $\Delta E=1$, CIE L*a*b color units
 - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
- E. Interior Daylight Sensors
1. Wired Daylight Sensor
 - a. Use Class 2 wiring for low voltage communication
 - b. Can be replaced without reprogramming
 - c. Open-loop basis for daylight sensor control scheme
 - d. Stable output over temperature from 0 degrees to 40 degrees C
 - e. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection
 - f. Provide linear response from 0 to 500 foot-candles
 - g. Integral IR receiver for programming
 - h. Constructed with plastic meeting UL94 HB
 - i. Mountable on lighting fixtures or recessed acoustical ceiling tiles
 - j. Constructed via sonic welding
 - k. Color:
 - 1) Match NEMA WD1, Section 2 White
 - 2) Color variation in same product family: Maximum $\Delta E=1$, CIE L*a*b color units
 - 3) Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.
 2. Wireless Daylight Sensor:
 - a. Product characteristics:
 - 1) Open-loop basis for daylight sensor control scheme
 - 2) Stable output over temperature from 0 degrees to 40 degrees C
 - 3) Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection
 - 4) Provide linear response from 0 to 10,000 foot-candles
 - b. Wireless Daylight Sensors shall:
 - 1) Have an operational lifetime of 10 years without the need to replace batteries when installed per manufacturer's instructions.
 - 2) Communicate directly to compatible RF receiving devices through use of a radio frequency communications link.
 - 3) Not require external power packs, power wiring, or communication wiring.

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- 4) Have the ability to be placed in test mode to verify correct operation from the face of the unit.
 - 5) Have a radio frequency range of up to 18.3 meters (60 feet) between sensor and compatible RF receiving device(s).
 - 6) Comply with the limits for a Class B device, pursuant to part 15 of the FCC rules.
 - 7) Color:
 - a) Match NEMA WD1, Section 2 White
 - c. Mounting:
 - 1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, compressed fiber ceilings.
 - 2) Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
 - 3) Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method shall be designed for easy, damage-free removal.
 - d. Shall meet California Title 24 Energy Efficiency Standard requirements.
- F. Exterior Daylight Sensors
1. Calibrated with independent turn-on and turn-off thresholds; minimum 2 foot-candles difference between the turn-on and turn-off thresholds.
 2. Enclosed in weatherproof housing with shading and lens protection visor.
- G. Infrared Partition Sensor
1. Provide contact closure based on status of the partition wall (open/close).

2.10 ACCESSORIES

- A. Emergency Lighting Interface:
1. Provides total system listing to UL924 when used with certain components
 2. Senses all three phases of building power.
 3. Provides an output to power panels or Digital Ballast Interfaces if power on any phase fails.
 4. Accepts a contact closure input from a fire alarm control panel.
- B. Infrared Transmitters:
1. Provide wireless remote control.
 2. Designed for use in conjunction with compatible infrared receiver and lighting control; compatibility dependent on that receiver, not transmitter.
 3. Operate up to 15 meters (50 feet) within line-of-sight to that receiver.
 4. "Learnable" by other variable frequency remote controls.

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- C. Wireless Controller
 - 1. Electronics:
 - a. Communicate via radio frequency to wireless control units within 9.144-meter (30-foot) range.
 - 2. Functionality:
 - a. Upon button press, LED to immediately illuminate.
 - b. Allow for easy reprogramming without replacing unit.
 - c. Provide wireless remote control of lighting zones or lighting and shade scenes on a wireless control unit.
 - 3. Mounting:
 - a. Controller shall be capable of being mounted with a car visor clip, table stand or directly to a wall with a Claro screwless faceplate.
 - b. Provide faceplates with concealed mounting hardware.
 - 4. Color:
 - a. [Match NEMA WD1, Section 2.] [Custom color to be selected.]
 - b. Color variation in same product family: Maximum $\Delta E=1$, CIE L^*a^*b color units.
 - c. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.11 SOURCE QUALITY CONTROL

- A. Perform full-function testing on completed assemblies at end of line. Statistical sampling is not acceptable.

- EXECUTION

2.12 INSTALLATION

- A. D Install equipment in accordance with manufacturer's installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.
- C. Define each dimmer's load type, shade settings, and set control functions.
- D. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- E. Mount exterior daylight sensors to point due north with constant view of daylight.
- F. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of

SECTION 26 51 03 - ARCHITECTURAL LIGHTING CONTROLS

luminaries.

G. [Systems Integration:

1. Equipment Integration Meeting Visit (LSC-INT-VISIT)
 - a. Facility Representative to coordinate meeting between Facility Representative, Systems Integrator, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures prior to system startup.]

H. Startup and Programming:

1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters
 - a. Qualifications for factory certified field service engineer:
 - 1) Minimum experience of 2 years training in the electrical/electronic field
 - 2) Certified by the equipment manufacturer on the system installed
 - b. Make first visit prior to installation of wiring. Review:
 - 1) Low voltage wiring requirements
 - 2) Separation of power and low voltage/data wiring
 - 3) Wire labeling
 - 4) Lighting Management Panel locations and installations
 - 5) Control locations
 - 6) Computer jack locations
 - 7) Load circuit wiring
 - 8) Network wiring requirements
 - 9) Connections to other equipment and other Lutron equipment
 - 10) Installer responsibilities
 - 11) Power Panel locations
 - c. Make second visit upon completion of installation of Network Lighting Control System:
 - 1) Verify connection of power wiring and load circuits
 - 2) Verify connection and location of controls
 - 3) Energize Lighting Management Panels and download system data program
 - 4) Address devices
 - 5) Verify proper connection of panel links (low voltage/data) and address panel
 - 6) Download system panel data to dimming/switching panels
 - 7) Check dimming panel load types and currents and supervise removal of by-pass jumpers
 - 8) Verify system operation control by control
 - 9) Verify proper operation of manufacturers interfacing equipment
 - 10) Verify proper operation of manufacturers supplied PC and installed programs
 - 11) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors
 - 12) Initial calibration of sensors

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- 13) Obtain sign-off on system functions
 - d. Make third visit to demonstrate and educate Owner's representative on system capabilities, operation and maintenance
 - b) Startup
 - a. Q-Admin configuration
 - 1) Naming and association of areas and lighting zones
 - b. After Hours Start-up
 - 1) Provide factory certified Field Service Engineer to perform manufacturer's start-up procedures outside normal working hours (Monday through Friday, 7a.m. to 5 p.m.)
- B. Training of customer representatives for Q-Admin
- 1. Configuration Software used to make system programming and configuration changes
 - 2. Control and Monitor
- C. Tech Support
- 1. Provide factory direct technical support hotline 24 hours per day, 7 days per week

3.1 FIELD QUALITY CONTROL:

- B. Manufacturer Services
- 1. Aim and Focus Visit
 - a. Facility Representative to coordinate on-site meeting with Lighting Control System Manufacturer and Lighting Design Consultant to make required lighting adjustments to the system for conformance with the Lighting Design Consultant's original design intent

2.13 CLOSEOUT ACTIVITIES

- A. Training Visit
- 1. Lighting Control System Manufacturer to provide 1day additional on-site system training to site personnel.
- B. On-site Walkthrough
- 1. Lighting Control System Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

2.14 MAINTENANCE

- A. Capable of providing on-site service support within 24 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.

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- B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

END OF SECTION 26 50 03

SECTION 267100 – ELECTRONIC SAFETY AND SECURITY SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 IMPOSED REGULATIONS:

- A. Applicable provisions of the State and Local Codes and of the following codes and standards are hereby imposed on a general basis for electrical work:
 1. *NEC, National Electrical Code (NFPA No. 70), with Georgia Amendments.*
 2. *Life Safety Code (NFPA No. 101), with Georgia Amendments.*
 3. *State of Georgia ADA Accessibility Guidelines for Building and Facilities.*
 4. *International Building Code, with Georgia Amendments.*
 5. *EIA/TIA Telecommunications Standards.*
 6. *National Fire Alarm Code (NFPA 72), with Georgia Amendments.*
 7. *U.L. Fire Resistance Directory.*
 8. *U.L. Electrical Construction Materials Directory.*
 9. *U.L. Electrical Appliance and Utilization Equipment Directory.*

1.3 DESCRIPTION OF WORK:

- A. Provide all labor, materials, equipment and supervision to construct complete and operable communication and alarm systems as indicated on the drawings and specified herein. All materials and equipment used shall be new, undamaged and free from any defects.
- B. Outlet boxes, raceway systems, cable trays, sleeves and line voltage power connections for Division 27 systems shall be provided under Division 26.

1.4 COORDINATION:

- A. Coordinate work provided under this division of the specifications with work provided under other divisions of the specifications and work provided by the Using Agency, where applicable.

1.5 PROJECT STAFFING:

- A. Superintendent:
 1. Provide a superintendent to plan, layout, supervise and coordinate the work by all organizations providing work under Division 27. The superintendent shall be at the job site at all times work is being performed.

2. The superintendent shall have a minimum of (5) years' experience in projects of similar size and scope. The Superintendent shall have a State of Georgia **Unrestricted Low Voltage License (LV-U)**.
- B. Organizations Furnishing and Installing Division 27 Systems: Division 27 systems are specified by the name of acceptable manufacturers. Each of the systems shall be furnished and installed by an organization that:
1. is an authorized and certified representative of the manufacturer, for purchase, installation, and service of the specific system.
 2. has current State of Georgia low voltage license appropriate for the system(s) being installed.
 3. stocks replacement parts for the specific system.
 4. has systems technicians in their employ
 5. has cable installers in their employ
 6. has experience on projects of similar size and scope.
 7. has been in business for at least 3 years.
 8. can respond to emergency service calls within (4) hours and routine service calls within (24) hours.
- C. Systems Technicians: The devices and equipment that make up each of the systems included in Division 27 shall be installed, started (where applicable) and tested by technicians in the employment of the organization furnishing the system. Technicians shall have at least one of the following:
1. *NICET Level II Engineering Technician Certificate* AND manufacturer authorized training, for the specific system to be installed.
 2. State of Georgia LV-A, LV-T or LV-U license AND manufacturer authorized training, for the specific system to be installed.
- D. Cable Installers: Cabling systems, including devices and terminations, for each of the systems included in Division 27, shall be installed, and tested by technicians in the employment of the organization furnishing the system. Technicians shall have State of Georgia LV-G license AND manufacturer authorized training, for the specific system to be installed.
- E. Helpers: Persons who do not possess the qualifications described herein shall be considered helpers. Helpers may assist technicians or cable installers, but shall not be allowed to install devices, make equipment connections, or perform other work for which they are not qualified. Helpers shall not perform any work on the project, at any time, without supervision by the Technician.
- F. Submit resumes for organizations, systems technicians and cable installers for review and approval by the Design Professional, prior to proceeding with any work on the project.

1.6 UTILITY CONNECTIONS:

- A. The approximate point of origination for electric, telephone, fiber optic and television utilities is shown on the drawings. Confirm the location with the respective utility prior to ordering materials or beginning any trenching. The Contractor's bid shall allow for the service point to be shifted by the utility 50' feet in any direction from that shown.

1.7 DIVISION 26 FIRE ALARM DRAWINGS:

- A. Do not scale the drawings. Obtain all dimensions from the Design Professional's dimensioned drawings, field measurements and shop drawings.
- B. Drawings are diagrammatic and indicate the general arrangement and connection of equipment and devices. The contractor shall review product data sheets, wiring diagrams, manufacturer's installation instructions, etc. and provide the connections required to place equipment into service.
- C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be brought to the attention of the Design Professional.

1.8 RECORD DOCUMENTS:

- A. The superintendent shall maintain a white set (blue-line or black-line) of contract documents in clean, undamaged condition, for mark-up of actual installations which vary substantially from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. These documents shall be used for no other purpose. As a minimum, record the following:
 - 1. Post all addenda prior to beginning work.
 - 2. Post all changes in the work.
 - 3. Scope of each change order (C.O.), noting C.O. number.

1.9 RECORD MANUALS:

- A. Manufacturer's operation and maintenance manuals for each Division 27 system.
- B. Shop drawings, revised to reflect all review comments, *supplemented with the installation instructions shipped with equipment.*
- C. As-built copy of the master cabling plan in AutoCad 2020 format, on USB flash drive.
- D. As-built copy of the system specific drawings in AutoCad 2020 format, on USB flash drive.
- E. Submit record manuals in quantities and in the format prescribed in the Division 01 specifications, plus one copy for the Design Professional.

1.10 TRAINING OF OWNERS FORCES:

- A. Train Owner's personnel on the operation and maintenance of the following systems:
 - 1. Fire Alarm System – (4) hours
- B. The "tour of facility" shall consist of a walk-thru of the entire facility. Demonstrate the operation of all devices, equipment and systems.

- C. *Training shall not be conducted until the final inspection of the work has been conducted by the Design Professional and all punch list items completed.*
- D. As a minimum, the following materials shall be reviewed during the training session:
 - 1. Owner's operation and maintenance manual.
 - 2. Corrected shop drawings and as-built system drawings.
 - 3. Hands-on demonstration of system features and operation.
- E. Notify the Design Professional, in writing, (10) working days in advance of each training session. Include a detailed agenda for the system. No more than two systems shall be covered in one day. The purpose of this requirement is to allow the Design Professional and Using Agency time to schedule representatives to be present, and is subject to the approval of the Design Professional.
- F. Training shall be conducted at the project site by authorized representatives of the system manufacturer and the Division 27 superintendent.

1.11 REVIEW OF THE WORK BY THE DESIGN PROFESSIONAL:

- A. During the course of the project, the work will be reviewed by a representative of the Design Professional. Upon each visit, demonstrate that the record documents and shop drawing files are being kept current.
- B. The Superintendent shall accompany the Design Professional on all reviews and shall provide all personnel, tools, ladders, etc. necessary to conduct the review.
- C. Prior to reviewing of work in progress, or at the final inspection, the Contractor shall submit a letter describing the specific work to be reviewed, along with a punch-list of items that are incomplete or which require correction, based on observations made by the supervisor of the given trade. Reviews will not be scheduled until this information is submitted. The Contractor shall bear the burden of any resulting delays.
- D. Construction review reports will be issued by the Design Professional for every review trip. Within five working days from the date of review, the Contractor shall submit a letter which addresses when corrections will be made for each deficiency in the report. Prior to subsequent review of the work, the Contractor shall submit a letter confirming that the work required by all comments on the report have been completed.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Refer to the drawings and individual specification sections for requirements.
- B. All equipment shall be suitable for the environment in which it is installed. Such considerations shall include, but not be limited to characteristics of this specific project such as wet/damp/dry locations, ambient temperature / humidity, spaces used as air plenums and hazardous locations. It shall be the responsibility of the contractor to review the contract

documents and order equipment based on intended use.

2.2 MATERIALS:

- A. All materials and equipment used shall be new, undamaged and free from any defects.
- B. Provide materials and equipment that are *UL* listed, unless listing is unavailable.
- C. All equipment of the same type or of the same product category shall be the product of a single manufacturer.
- D. Where product is specified by catalog number, such specification is intended only to convey general characteristics. Actual product selection shall be based on catalog number, other references on the drawings / specifications and intended use.

2.3 ACCEPTABLE MANUFACTURERS:

- A. Provide equipment and materials which are products of the manufacturers listed on the drawings and in the specifications. Requests for substitution of other manufacturers shall comply with Division 01 and the paragraph "B" below.
- B. Requests for prior approval (i.e., before the bid opening) must contain all information listed for the specific item in Section 270120, including any applicable dimensioned layout drawings. Requests must be sent by mail or express delivery such that they are received in the Design Professional's office no later than (10) working days prior to the opening of bids. Requests that are incomplete or are sent by facsimile will not be reviewed.

2.4 SPECIAL REQUIREMENTS:

- A. All software-based electronic equipment shall use the manufacturer's current software version as of the project bid date.

PART 3 - EXECUTION

3.1 ROLE OF THE SUPERINTENDENT:

- A. The Division 27 Superintendent's duties shall include, but not be limited to the following:
 - 1. Preparation of submittals.
 - 2. Planning and layout of the work.
 - 3. Coordination with other trades and the local utility companies.
 - 4. Posting addenda and changes in the work to maintain the Record Drawings and to ensure that Division 27 personnel are working from up-to-date drawings and specifications.
 - 5. Supervision of all Division 27 personnel.
 - 6. Ongoing review of work in place to ensure compliance with the Contract Documents.
 - 7. Conducting a review of the work in place and materials stored for the Design Professional's representative.

8. Administrative duties as required to fulfill the requirements of the General Conditions, Special Conditions and Division 01 specifications.
9. Training of the Owner's Forces.

3.2 PROTECTION OF THE WORK:

- A. Protect the work during the course of construction. Do not install any equipment or materials until the proper environmental conditions have been established.
- B. Store materials in the manner recommended by the manufacturer until materials are installed. Materials rated for indoor use shall not be stored outdoors regardless of the packaging in which the materials are shipped.
- C. Do not install cables until the building is dried-in. For the purposes of this specification "dried in" shall mean the roof has been installed, all exterior openings are covered and the interior of the building is dry. Tape ends of all conductors to protect from damage. Coil cables and hang from the building structure. Use care not to exceed cable bending radius. *Under no circumstances shall cables be laid out on the floor.*
- D. ***Protect equipment and cables from being painted. Any equipment or cables that are painted shall be removed and replaced with new. Cleaning of paint from item is not an acceptable substitute.***
- E. *Do not install devices, or equipment until spaces are broom clean and the building is conditioned.*
- F. Install temporary protective covers over equipment enclosures, devices and similar items after interiors, conductors, devices, etc. are installed to protect the installation during finish work performed by others.
- G. Clean all equipment, inside and out, upon completion of the work. Scratched or marred surfaces shall be touched-up with touch-up paint furnished by the equipment manufacturer.
- H. Equipment or materials that are improperly stored or are installed before the proper environmental conditions are achieved will be removed and replaced with new, at no cost to the Owner. The Contractor shall bear all consequences from any resulting delays.
- I. All equipment and materials that become damaged will be removed and replaced with new, at no additional cost to the Owner.

3.3 INTERFACE OF WORK WITH OTHER TRADES:

- A. Where Division 27 work must adjoin, abut or be incorporated into work installed by other trades, engage the services of the other trade to interface the work. Under no circumstances shall the installer performing work under this Division of the specifications modify or alter work installed by others. Such work includes, but is not limited to:
 1. Roof Penetrations.
 2. Any attachments to roofing system.
 3. Penetrations in Vapor Barriers.

4. Exterior Insulation and Finish Systems (EIFS).

END OF SECTION 267100

SECTION 27120 – ELECTRONIC SAFETY AND SECURITY SYSTEMS SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

- A. Submit for review by the Design Professional, a schedule with engineering data of materials and equipment to be incorporated in the work.
 - 1. Submittals shall be supported by descriptive materials, i.e., catalog sheets, product data sheets, diagrams, performance curves and charts published by the manufacturer, to show conformance to Specifications and Plan requirements; model numbers alone shall not be acceptable.
 - 2. Data submitted for review shall contain all information to indicate compliance with Contract Documents. Complete characteristics shall be provided for all equipment.
 - 3. The Design Professional reserves the rights to require samples of any equipment to be submitted for review.
- B. For each product group and type, provide a letter from the product manufacturer stating requirements for storing and handling at the job site prior to installing the product. The manufacturer shall specifically address acceptable temperature and relative humidity levels.
- C. All submittals shall be prepared by the organization furnishing the system. Submittals shall be checked for compliance by the Division 27 superintendent prior to submission.
- D. Hard Copy Submittals: Submittal data shall be placed in one or more hard-back 3-ring binders arranged and labeled according to specification section. Each binder shall contain a title page and table of contents. Provide separator tabs, and label by specification section. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 27 Superintendent's name, Suppliers and point of contact for each, and date. Except as otherwise indicated in other sections, submit 5 complete copies. Quantity indicated does not include copies required for regulatory agencies.
- E. Electronic Submittals: All electronic submittal files shall be organized to match the bid documents for specification section and name. Each submittal file shall be complete for each specification section. Multiple partial submittals per specification section will be rejected. Make note in the table of contents, any drawings that accompany the submittal. Title page shall contain Project Name, Contractor's Name, Division 27 Superintendent's name, Suppliers and point of contact for each, and date.

1.3 RESPONSE TO SUBMITTALS:

- A. Each item reviewed by the Design Professional will be marked with numerical review codes that correspond to the following:
 - 1. **"No Exceptions Taken"**: No corrections, no marks. Items may be ordered.
 - 2. **"Make Corrections Noted"**: A few minor corrections. Items may be ordered as marked up without further resubmission.
 - 3. **"Revise and Resubmit"**: Minor correction. Item may be ordered at the Contractor's option. Contractor shall resubmit drawings with corrections noted.
 - 4. **"Rejected"**: Major corrections or not in accordance with the contract documents. No items shall be ordered. Contractor shall correct and resubmit drawings.
- B. Whether resubmittals are required or not, all shop drawings shall be corrected for the record manuals specified in Section 270100.

1.4 SUBMITTAL GROUPING:

- A. Submittals shall be made in the following groupings:
 - 1. Group 1
 - a. Fire Alarm System – 271010.
 - b. Area of Refuge Assistance 267300
- B. System specific drawings shall be submitted with the respective specification section.
- C. Submittals that do not comply with these requirements or that are deemed by the Design Professional to be incorrect or incomplete shall be returned without review. The Contractor shall bear the burden of any resulting delays.
- D. Resubmittals must be scheduled (2) weeks in advance with the Design Professional. Resubmittals must be accompanied by a letter from the Contractor, with a copy of the previous submittal report, stating the resubmittal has incorporated all comments made on the previous report. Resubmittals made without this information shall be returned without review. The Contractor shall bear the burden of any resulting delays.

1.5 TESTING / TRAINING SCHEDULES AND TEST RESULT SUBMITTALS:

- A. Submittals shall be made for each occurrence. Each submittal shall include a cover letter with the Contractor's letterhead.

1.6 EQUIPMENT AND MATERIALS REQUIRING SUBMITTALS:

- A. Section 267100 - General Provisions - Communications and Alarm Systems
 - 1. Superintendent's qualifications
 - 2. Installers' qualifications (as applicable for each system)
- B. Section 267120 - Communications and Alarm Systems Submittals
 - 1. System specific rough-in details
 - 2. Attachment 1
- C. Section 267130 - Intelligent Fire Alarm System

1. Draft copy of *NFPA 72 Certification*
 2. Proof of Coordination with other trades.
 3. Fire Alarm Control Panel
 4. Remote annunciator / Remote trouble station
 5. Power Supplies
 6. Batteries
 7. Calculations - Power Supply, Battery Sizing, and Wire Sizing
 8. Voice Alarm Control Panel
 9. Pull Stations
 10. Audible and audible/visible signaling devices
 11. Door Holders
 12. Flow and Tamper Switches
 13. Monitor and control modules
 14. Detectors and detector bases / housings
 15. Cables
 16. System specific drawings, per 267120, 3.04.B, plus interlock diagrams which shall include, as a minimum:
 - a. Air Handler shutdown.
 - b. Interconnections to the electronic card entry / access system.
 - c. Elevator Recall and emergency shutdown.
- D. Section 267211 - Cable Plant Labeling
1. Product data sheets for each type label.

PART 2 – PRODUCTS NOT APPLICABLE

PART 3 - EXECUTION

3.1 MANUFACTURER’S DATA:

- A. For each system component, include the manufacturer's comprehensive product data sheet and installation instructions. Where operating ranges are shown, mark data to show portion of range required for project application.
- B. Provide manufacturer’s product data sheet for each type of cable used. Include cross-section diagram of the cable assembly.

3.2 CALCULATIONS:

- A. Provide calculations to substantiate the sizing of power supplies, transformers, backup batteries and similar items.

3.3 TEST REPORTS:

- A. Submit test reports which have been signed and dated by the firm performing the tests and prepare in the manner specified in the standard or regulation governing the tests procedure as

indicated.

3.4 LAYOUT AND COORDINATION DRAWINGS:

3.5 ATTACHMENT NO. 1:

A. Shall be filled out and returned with shop drawings. List all firms that will be providing work under Division 27.

ATTACHMENT NO. 1

The purpose of this form is to identify all organizations that will provide the work of Division 27, and describe how the work will be divided.

ORGANIZATION:

SYSTEM TO BE INSTALLED: FIRE ALARM SYSTEM

SYSTEM MANUFACTURER:

ORGANIZATION:

SYSTEM TO BE INSTALLED: AREA OF REFUGE ASSISTANCE

SYSTEM MANUFACTURER:

ORGANIZATION:

Attach a letter from each organization stating that they acknowledge and will comply with the staffing requirements of Section 270100 and that the proposed subdivision of work of Division 27, among the organizations will not compromise the integrity of the systems and does not conflict with recommendations of the equipment manufacturer, or applicable codes.

END OF SECTION 270120

SECTION 267130 - INTELLIGENT FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION:

- A. The work required under this section of the specifications consists of an analog, addressable fire and voice alarm system.
- B. *This is a performance-based specification.* The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer who is either a registered *Fire Protection Engineer* or a *NICET Certified Engineering Technologist*.
- C. Work of this section requires coordination with the following trades:
 - 1. Duct work installer.
 - 2. Elevator installer.
 - 3. Electrical system installer.
 - 4. Fire water service installer.
 - 5. Sprinkler installer.
 - 6. Fire pump installer.
 - 7. Electronic card access and door hardware installer(s).
- D. Proof of this coordination shall be submitted with the shop drawings.

1.3 QUALITY ASSURANCE:

- A. All components shall be *UL Listed* for their intended use as part of the Intelligent Fire Alarm System. Non-listed equipment shall not be used.
- B. No equipment shall be installed, nor auxiliary connections made that will inhibit proper operation or use of the system and its components, in accordance with the *UL* listings.
- C. Acceptable manufacturers: *Notifier, Edwards EST, Simplex.*
- D. Submittals: Refer to Section 270120 for requirements. A draft copy of the certification required by *NFPA 72* shall be submitted with the shop drawings. Fill-in as much information as possible. Submittals made without this information will be rejected.

1.4 COORDINATION:

- A. Coordinate control, supervisory and auxiliary functions with work provided under other

Divisions.

1.5 PERFORMANCE CRITERIA:

- A. When installed, the system shall comply with the requirements of the State of Georgia *ADA*, *NFPA 72*, and *NFPA 101*.
- B. All *NFPA 72*. All fire alarm drawings **shall** use symbols described in *NFPA 170, Standard for Fire Safety and Emergency Symbols*".
- C. *NFPA 170* is part of the Performance Criteria.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All equipment, components and software shall be new and the manufacturer's current model. Beta versions are not acceptable.
- B. Provide and activate all standard alarm, trouble, control, and supervisory functions. Provide special functions as specified herein.

2.2 FIRE ALARM CONTROL PANEL:

- A. The fire alarm control panel shall comply with the manufacturer's standard design, materials, and components for an **intelligent** fire alarm system with **addressable** devices, plus the following accessories:
- B. A digital communicator for transmitting alarm and trouble conditions over the telephone line to a central station receiver. Provide surge suppression on all telephone lines connecting to the digital communicator. The system shall be capable of transmitting alarms, supervisory and trouble signals to a 3rd party monitoring company. Coordinate with owner to determine which 3rd party monitoring company is being used. Device shall be provided with an IP/GSM Communicator. Provide (1) internet data drop adjacent to the control panel.
- C. A dedicated supervisory service LED and a dedicated supervisory service acknowledge switch, for the building sprinkler system.

2.3 VOICE ALARM PANELS:

- A. Provide voice alarm integral with the fire alarm panel.
- B. Voice alarm feature shall be capable of transmitting automatic or manual messages to fire alarm speakers. However, panels shall be configured for automatic operation.
- C. Provide remote microphones at locations shown on drawings.

2.4 DOCUMENTATION CABINET:

- A. Provide documentation cabinet located at the fire alarm control panel. Documentation cabinet shall house all record documentation required by *NFPA 72*.
- B. Label documentation cabinet "SYSTEM RECORD DOCUMENTS".

2.5 REMOTE ANNUNCIATOR:

- A. The annunciator panel shall be recess mounted at location noted on the drawings and shall have an LCD readout. Each alarm initiating device (pull station, smoke detector, duct detector, and sprinkler system flow switch) shall be identified on the readout.

2.6 POWER SUPPLIES:

- A. Provide power supplies in the quantity and size required to operate the devices connected to the system. Do not load any power supply more than 75% of its rating.
- B. Group devices of the same type to the same power supply.
- C. Remote power supplies are permitted providing:
 - 1. Location is approved by the Design Professional.
 - 2. A separate 20A / 120V circuit is installed to operate each remote supply.
 - 3. Backup battery system is installed at the location of each remote power supply.

2.7 BACKUP BATTERY SYSTEM:

- A. An automatic battery back-up and recharging system with voltmeter and ammeter for supporting the entire system for a period of (24) hours under normal conditions with (5) minutes of alarm time at the end of the (24)-hour period. The battery back-up shall also be able to support the one-way voice communications and tone generator under maximum normal load for (24) hours and then shall be capable of operating the system during a fire or other emergency condition for a period of (2) hours. (15) minutes of evacuation alarm operation at maximum connected load shall be considered the equivalent of (2) hours of emergency operation.
- B. Install batteries in a separate cabinet adjacent to the control panel / remote power supply.

2.8 SIGNALING LINE CIRCUITS:

- A. Circuits shall be Class B, Style 4.

2.9 NOTIFICATION APPLIANCE CIRCUITS:

A. Circuits shall be Class B, Style Y.

2.10 SYSTEM OPERATION:

A. The system shall be designed, installed, and connected to receive and process signals in accordance with *NFPA 72*.

B. Control Actions Upon Receipt of Fire Alarm Signal:

1. Doors in fire walls, held open by magnetic devices, shall close, via interface with control module.
2. All doors locked by the electronic card entry/control system shall be unlocked, via interface with control module. The electronic card entry/control system is being provided by the Owner. It shall be the responsibility of the contractor to meet with the Owner's designated representative and determine the requirements.
3. Air handling units equipped with smoke detectors shall be de-energized, via interface with control module.
4. Smoke dampers in duct work shall close, via interface with control module.
5. The alarm activation of any elevator lobby, elevator shaft or elevator equipment room detector shall cause the elevator cabs to be recalled in accordance with *ASME A17.1*.
6. The alarm activation of any heat detectors in the elevator shaft or elevator machine room shall cause shutdown of elevator power and lighting circuits as required by *ASME A17.1*.
7. The activation of projected beam detectors shall initiate the actions described in the applicable sections of Division 23 for smoke removal.

C. Supervisory Functions:

1. Sprinkler system flow and tamper switches per *NFPA 72*, via interface with monitor module.
2. Fire service post indicator valve per *NFPA 72*, via interface with monitor module.
3. Elevator sump pump oil monitoring system.

D. Auxiliary Functions:

1. Upon receiving a signal from the electronic card entry/control system, release doors held open during the day, but closed and operated by card access at night, via interface with control module.

2.11 NON-ADDRESSABLE DEVICES:

A. Audible Alarm Indicating Appliances:

1. Audible signals shall be manufacturer's standard horn or speaker, as indicated, and shall be suitable for surface mounting on the wall.
2. Horns shall have field-selectable "standard" and "high" settings.
3. Speakers shall have field-selectable taps from 1/8W to 8W.
4. Enclosure shall be white.

B. Visual Alarm Indicating Appliances:

1. Visual signals shall be manufacturer's standard, suitable for surface mounting on the wall.
2. Devices shall have field-selectable candela settings of 15, 30, 75 or 100 cd.

3. **Enclosure shall be white.** Lens shall be vandal resistant.
- C. Audio/Visual Alarm Indicating Appliances:
1. Combination audible / visible signals shall be manufacturers' standard, the same as defined for individual devices.
- D. Door Holders:
1. Magnetic door holders shall be manufacturer's standard and shall have an approximate holding force of (35) lbs.
 2. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Wall unit shall be semi-flush mounted over recessed outlet box.
 3. Door holders shall be 24V dc and shall be powered from the control panel.
 4. Door holders shall be wall mounted type unless floor mounted type is required. Door holders shall be compatible with Architectural building features and doors specified.
- E. Thermal Detector Head:
1. Detectors will be a combination rate-of-rise and fixed temperature (200 F) type, automatically restorable. These devices shall be used only in spaces where high ambient temperatures prohibit the use of addressable devices. Unless noted otherwise, each of these devices shall be used in conjunction with a monitor module, such that point identification is maintained.
- F. Waterflow Switches:
1. Flow switches are furnished and installed under Division 21 and connected under this Division.
- G. Sprinkler Valve Tamper Switches:
1. Tamper switches are furnished and installed under Division 21 and connected under this Division.
- H. Post Indicator Valves:
1. Post Indicator Valves are furnished and installed under Division 21 and connected under this Division.

2.12 ADDRESSABLE DEVICES:

- A. Pull Stations:
1. Pull stations shall contain electronics that communicate the station's status to the control panel over two wires. Station address shall be field-selectable.
 2. Stations shall be double-action type.
 3. Enclosure shall be red, high-impact, vandal-resistant type.
 4. Station address shall be field-selectable.
- B. Thermal Detector Head:
1. They will be combination rate-of-rise and fixed temperature (135 F) type, automatically restorable.
 2. Station address shall be field-selectable.
- C. Smoke Sensors:
1. Smoke sensors shall be of the photoelectric or ionization type and shall communicate

actual smoke chamber values to the system control panel. Sensors installed in elevator shafts or pits shall be suitable for the environment.

2. Sensors shall be low profile.
 3. Station address shall be field-selectable.
 4. Set points shall be field-selectable from the control panel.
 5. Sensor shall have integral test switch.
 6. Sensor heads shall be photoelectric or ionization type, as determined by the manufacturer to best suit the environment in which the device is to be installed.
- D. Addressable Duct Smoke Detector:
1. Addressable Duct Smoke Detectors shall be of the photoelectric type specified above, for mounting outside of the air stream.
 2. Provide housing to allow installation on the side of air duct.
 3. Provide sampling tubes.
 4. Provide and install an externally mounted addressable control module for each duct mounted smoke detector shown on Division 23 plans and/or details and program system as necessary for required automatic shut-down.
 5. For each duct detector location provide one remote indicator / test switch unit. The unit shall provide status of the detector (normal, alarm, and trouble). Flush mount in wall near entrance to room in which air unit is installed.
- E. Addressable Monitor Modules:
1. Addressable monitor modules shall provide point-monitoring capabilities of individual non-addressable devices. Provide a separate module for each such device.
 2. Locate within 3' of the device to be monitored.
- F. Addressable Control Module:
1. Addressable control modules shall be used to initiate control actions and supervise initiating functions. A separate control module shall be provided for each control point. Initiation of control functions from auxiliary contacts in devices is prohibited.
 2. Locate within 3' of the device to be controlled.
 3. If the power requirements of the device being controlled exceed the contact rating of control module, provide a general-purpose relay, controlled by the module, with the required contact rating to support the load.

2.13 REMOTE COMMUNICATION DEVICES:

- A. Provide active RS-232 port for connection of printer.
- B. Provide remote LCD annunciator (non-control type) in location shown on plans.

PART 3 - EXECUTION

3.1 WIRING:

- A. Refer to Section 267910, Wiring Methods for Communications Systems.
- B. Label each piece of equipment and each cable, using *NFPA 72* requirements/

recommendations. Label each end of all cables. Labels shall be of same type as specified in Section 272011.

- C. Provide all wiring required to make system operable, as specified. Leave 25% spare capacity on each circuit for the future addition of devices and appliances. Voltage drop calculations shall substantiate initial load and load that can be added.
- D. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment/device terminals.

3.2 CONDUCTORS:

- A. Provide cable type construction, listed, and approved for fire alarm usage.
- B. Cables shall comply with *NEC Article 760*, be red in color and be identified in all enclosures.
- C. ***All cables shall be installed in a metallic conduit system***, in accordance with Section 261010. Minimum conduit size shall be 3/4". All junction boxes shall be painted red.

3.3 DEVICES:

- A. The location of devices shown is approximate. The exact location of all devices shall be determined by the system designer.
- B. It shall be the responsibility of the contractor to provide suitable mounts for the projected beam detectors, to guard against movement which would prevent nuisance alarms, to the greatest degree possible.

3.4 DISCONNECT LABELING:

- A. The panel and circuit number serving the control panel shall be marked with an indelible marker pen on the inside door of the control panel.

3.5 NOTIFICATION APPLIANCES:

- A. The sound level and light intensity setting of notification devices shall be determined by the system designer.

3.6 DUCT MOUNTED DETECTORS:

- A. Refer to the Division 23 drawings for the quantity and location of duct mounted smoke detectors.
- B. The duct work installer shall determine the method of mounting the detector housing and shall also provide an access door in the duct work on the side opposite of the detector, for inspection of the sampling tubes.

3.7 PRELIMINARY TESTS:

- A. Upon completion of the installation, test the entire system for proper operation. Make all adjustments and corrections necessary. Retest until proper operation is achieved.

3.8 CUSTOMIZATION:

- A. Schedule on-site meeting (allow a minimum of (4) hours) with Owner's designated representative and review system operation to:
 - 1. Determine custom labels.
 - 2. Customize software programming for initiation, notification, and control circuits.
 - 3. Review all adjustable features and determine setpoints.
 - 4. Determine access levels and assign passwords.
 - 5. Implement customization based on meeting with Owner. Document all settings and provide hard copy.

3.9 FINAL TEST:

- A. After customizing system, perform an acceptance test of the system as required by *NFPA 72*. Upon completion of tests, print alarm history log to verify tests.
- B. Upon successful completion of tests, provide written certification per *NFPA 72*. Submit form with record documents.
- C. Review test results with Owner and Design Professional. Demonstrate system operation as directed.
- D. Arrange final inspection with the Fire Marshal and Owner's Insurance representative. Present copy of final test alarm log and *NFPA Certification* to each. Demonstrate operation of system as directed.
- E. Any changes made to the system after or as a result of the test shall require re-acceptance testing as required by *NFPA 72*.

3.10 SPARE PARTS:

- A. Provide spare parts as follows:

1. Sensor heads:	10 of each type
2. Sensor bases:	10 of each type
3. Manual stations:	5
4. Notification appliances:	10 of each type
5. Control and monitor modules:	10 of each type
- B. Deliver in unopened factory cartons at time of training. Submit receipt, signed by Owner's representative.

END OF SECTION 271010

COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BR-82-2001
PERMIT SUBMITTAL
APRIL 2024

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SECTION 267211 – ELECTRONIC SAFETY AND SECURITY CABLE PLANT LABELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 GENERAL:

- A. Provide labels for all cables, device faceplates, equipment and equipment ports, installed on this project, as specified herein.
- B. Colors for cables and devices are specified in the respective system specification section.
- C. Device plate numbers within a room or space shall be assigned based on the “plan” view of the room or space, starting on the left side of the “top” wall and proceeding around the room to the “right”, “bottom” and “left” walls. Any remaining devices (i.e. floor or column-mounted outlets in the middle of the room), shall be then counted from left-to-right, top-to-bottom.

1.3 QUALITY ASSURANCE:

- A. Labeling materials described herein are the product of *Panduit*. Products of other cabling system manufacturers’ listed in Specification Section 272011, and complying with the requirements specified herein, are acceptable.
- B. Submittals: Refer to Section 270120 for requirements. Labels shall be included on layout drawings.

1.4 SYSTEM IDENTIFICATION STRINGS:

A. Fire Alarm:

1. Cable: Provide a label at each end of all cables and at any interim points of termination.
FA-SLC-PL-01
FA = Fire Alarm
SLC = Signaling line circuit or NAC = Notification Appliance Circuit
PL= Power limited circuit or NPL = Non-power limited circuit
01 = Circuit number or loop number
2. Device: Provide a label for each device.
ID-01-001

ID =Initiating Device, CD=Control Device, NA=Notification Appliance
01=Circuit number or loop number
001=Unique device point identification

PART 2 - PRODUCTS

2.1 LABEL GENERATION:

- A. Labels shall be made using labeling software and thermal transfer printer, purchased for this project by the Contractor.
- B. The software shall be installed on, and the printer connected to, a computer designated by the Using Agency. The Contractor shall make all labels using this computer.
- C. The labeling software license and the printer shall become the property of the Using Agency.
- D. Provide ink / toner and sufficient label stock to print all labels for this project plus 100% spare, of each type. Provide a heat shrink tool for applying labels. Tool shall become the property of the Using Agency.

2.2 LABELS:

- A. Cable labels shall be heat shrink type with clear protective cover. Select size and type based on individual cable characteristics. Use black letters on white background except for data / voice / IP cables that exceed the maximum design length. In such cases labels shall be red on white background.
- B. Faceplate labels shall be adhesive-backed component label, compatible with label window in faceplate.
- C. Equipment port labels shall be adhesive-backed component label, compatible with label area.
- D. Equipment and device labels shall be adhesive-backed component label, affixed to the back side of item, or in an otherwise accessible but inconspicuous location.
- E. Set lettering height for each type label to provide the largest font possible in the space available. Boldface Arial font is preferred. However, labels shall be sized and formatted such that they can be read from a distance of 24".

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Cable labels defined herein shall not be applied until the cables have been terminated and trimmed. Provide temporary labels at the time of cable installation. Temporary labels shall have the same information as permanent labels.
- B. Use extreme caution when applying heat shrink labels.
- C. Apply cable labels within 2" of termination, or fan-out, such that the lettering is visible

without twisting or bending the cable.

END OF SECTION 272011

SECTION 267300 – AREA OF REFUGE ASSISTANCE COMMUNICATIONS SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SCOPE OF WORK:

- A. Provide a complete operational system as indicated on the drawings and as specified herein.
- B. *This is a performance-based specification.* The system specified herein shall be designed by the manufacturer or an authorized representative of the manufacturer. All hardware, cabling, and programming required to provide the system described below shall be provided.

1.3 QUALITY ASSURANCE:

- A. Acceptable Manufacturer's: *Rath, Talkaphone*, or prior approved manufacturer.
- B. Submittals: Refer to Section 270120 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIAL:

- A. All equipment, components and software shall be new and the manufacturer's current model. Beta versions are not acceptable.

2.2 FEATURES AND FUNCTIONS:

- A. The area of refuge communications and system shall be a comprehensive communications network with the following features and functions. Capacity for the number of stations indicated on the drawings plus 20% spare.

2.3 EQUIPMENT:

- A. Base Station:
 - 1. The Base Station shall be located at a central control point on the first floor as indicated on the plan or as determined by local Authority having jurisdiction. The Base Station shall be capable of receiving input from a minimum of (5) Call Boxes. The base station shall have visual LED indicator lights, one for each call box. The Base Station shall

allow communication to all call boxes simultaneously and to each individual Call Box. The Base Station shall provide an audible and visual indicator when a Call Box has been activated.

2. The Base Station shall be flush mounted, equal to *Rath models 2500-205FM*, with stainless steel housing, red coil cord emergency Handset, be 24vdc or 120vac powered and include a rechargeable battery to maintain backup power for a minimum of (4) hours of Talk time.
- B. Call Boxes:
1. Call boxes shall be *ADA* compliant, vandal resistant hands-free speakerphone with LED indicators to indicate status of call. Call Box shall be hands-free with a push-button-once to talk system. Upon activation of the emergency push button at the Call Box, a call shall be transmitted to the Base Station. If no answers at the Base Station, the Call Box shall automatically dial a secondary location outside the building to activate two-way off-site person to person voice communications. Call Boxes shall be programmed with (5) emergency phone numbers. Each Call Boxes shall be programed with its specific location. The programmed location shall indicate at the Base Station upon activation of the Call Box.
 2. Call Box features:
 - a. Five number programming.
 - b. Operating Temperature of between -40 F to +150 F (-40 C to + 65 C)
 - c. Programmable passwords.
 - d. On-Site or Remote Programmable.
 - e. EEPROM memory to protect programming.
 - f. Braille faceplate.
 3. Call Boxes shall be flush mounted, equal to *Rath models 2100-958NSR*.
- C. Strobe:
1. When Call Station is activated, a strobe shall begin flashing at the Base Station location. Strobe shall continue to flash as long as any Call Stations are active.
 2. Strobe shall be rated at 15-candela and flash (60) times per minute.
- D. Power supplies:
1. Provide 24vdc Power Supply. System shall be capable of supplying power to a minimum of (10) Call Boxes and the Base Station.
 2. Power Supply shall be equal to *Rath model 2500-PWR24*.

2.4 EMERGENCY CALLS:

- A. Once the Call Box button has been pushed, the Call Box shall call the Base Station. If no answer at the Base Station, it will automatically call preprogrammed emergency numbers. Call Box shall have Location Messaging. Call Box shall have a minimum (18) second recordable message, programmable to play (2) times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center. Call Box shall be capable of allowing the called party to replay the Location Message if necessary to ensure an understanding of the caller location. If system is not attended the Call Box shall dial a secondary location outside the building to activate two-way off-site person to person voice communications. Once a call has been made (button pushed), the call can only be terminated by the called party. Call Box shall have a red LED that illuminate upon activation of the button. The light shall be a solid color when the Call Box is activated and will flash when call

has been answered.

- B. The system shall be capable of being programmed and reprogrammed on-site and remotely.

PART 3 – EXECUTION

3.1 INSTALLATION OF EQUIPMENT:

- A. Install equipment where shown, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that the equipment complies with these requirements and serves the intended purposes. Comply with the requirements of *National Electrical Code* and applicable portions of *NECA "Standard of Installation"* pertaining to general electrical installation practices. Ground equipment enclosures, surge arrestors and cable shields in accordance with the *National Electrical Code*.

3.2 WIRING:

- A. Wiring is not shown on the drawings. Provide wiring of the type recommended by the system manufacturer. Wiring shall run unspliced. Install all wiring in accordance Section 279010. Provide phone line to base station.
- B. All emergency communication wiring shall be (2)-hour fire-rated circuit integrity cable installed in metallic raceways. Cable shall be *UL 2196 Listed*.

3.3 TESTING:

- A. Upon completion of installation of equipment, test to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting until specified operation is achieved. Do not proceed with in-service training until the system is fully operational.

3.4 PROGRAMMING:

- A. After system start-up and prior to final testing, schedule on-site meeting with the Owner's representative to discuss desired programming of system. Program as directed. Provide documentation and include in record manuals. Allow an (8)-hour day.

END OF SECTION 273000

SECTION 267910 - WIRING METHODS FOR FIRE ALARM 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 DESCRIPTION:

- A. The work required by this section of the specifications applies to all systems specified under Division 26 and the HVAC systems control cabling specified under Division 23.
- B. Installation of outlet boxes, raceway systems is specified under Division 26.

1.3 QUALITY ASSURANCE:

- A. Submittals: Refer to Section 267120.

PART 2 - PRODUCTS

2.1 CABLE CHARACTERISTICS:

- A. Wire size, shielding and insulation requirements for cables shall be determined by the system manufacturer for each system based on specific system requirements, the *National Electrical Code* and *EIA/TIA* standards.
- B. Cables installed outdoors or run below grade shall be suitable for use in wet locations.

2.2 SURGE SUPPRESSION:

- A. Provide surge protection for conductors in accordance with *NEC Article 800*, where conductors enter and exit buildings.
- B. Provide surge protection for the 120V incoming power connections to all headend equipment.

PART 3 - EXECUTION

3.1 GENERAL:

- A. All fire alarm cabling shall be installed in conduit system.

3.2 MASTER CABLING PLAN:

- A. The Contractor shall develop a Master Cabling Plan as defined in Section 267120. The approved plan shall become the basis of installation for all systems governed by this section of the work.

3.3 CABLE SYSTEM AND CONDUIT SYSTEM ROUTES:

- A. Complete conduit system required:
 - 1. Cables shall be installed in a complete conduit system installed under Division 26.

END OF SECTION 279010

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Specifications, Standards, and Codes

1. All work shall be in accordance with the following:
 - a. This Technical Specification and Associated Drawings
 - b. TIA/EIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
 - c. TIA/EIA 568-C.1 Commercial Building Telecommunications Cabling Standard
 - d. TIA/EIA 568-C.2 Balanced Twisted Pair Cabling Components Standard
 - e. TIA/EIA 568-C.3 Optical Fiber Cabling Components Standard
 - f. TIA/EIA 942 Telecommunications Infrastructure for Data Centers
 - g. TIA/TIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces
 - h. TIA/EIA 606-A Administration Standard for the Telecommunications Infrastructure of Commercial
 - i. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - j. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard
 - k. National Fire Protection Agency (NFPA)-70 National Electric Code (NEC)
 - l. UL 50 Enclosures for Electrical Equipment
 - m. Current design and installation contractor agreement with single solution manufacturer.
2. If a conflict exists between applicable documents that cannot be verbally negotiated between the contractor and the owner, then the order in the list above starting with #1 above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency. If a conflict is found, it shall be the discovering party's responsibility to notify the Architect of these specifications for clarification and resolution.
3. The contractor shall comply with all requirements for permits and tests, shall provide all certificates, and shall pay all costs for same.

B. SCOPE

1. The work to be done under this Section of the Specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.

2. All materials, obviously a part of the Telecommunications Infrastructures and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
3. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the architect shall be notified of the discrepancy.

1.2 WORK INCLUDED

- A. The Communications Infrastructures installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
 1. Horizontal and Backbone Cabling Infrastructure
 2. Telecommunications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards as indicated on the Drawings.
 3. Grounding and Bonding
 4. Concrete work for wall and floor penetration.

1.3 DEFINITIONS

- A. Terms: The following definitions of terms supplement those of the GENERAL REQUIREMENTS and are applicable to the TELECOMMUNICATIONS WORK SCOPE.
- B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete".
- C. Infrastructure: As used herein shall mean cable, installed in conduit, raceway, or cable tray with all required boxes, fittings, connectors, and accessories; completely installed."
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.4 DRAWINGS

- A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop Drawings, equipment location Drawings, foundation Drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

- C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.
- E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.
- F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes
- G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Technology plans.
- H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.
- I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.
- J. Review all architectural Drawings for modular furniture.
- K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "In accordance with", "a", "the" and "all are intended" shall be supplied by inference.

1.5 SUBMITTALS

- A. Before installation of any cable or support equipment the contractor shall submit shop drawings and product data for the RCDD and designer for review and approval. The contractor shall indicate installation details, cable routing, system configurations, and outlet numbering on all drawings. The contractor shall submit all appropriate product data for each component to be supplied. The contractor shall also submit manufacturer installation instructions. Three (3) copies of all the above and following shall be submitted.
- B. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.

- C. Immediately after reward, the contractor shall submit a construction schedule listing construction milestones including: delivery of construction materials, staffing, backbone installations, equipment room fit-out, horizontal cable installation, testing, and pre-final and final construction observations.
- D. Also after reward, contractor to submit Schedule of Value that coincides with construction schedule. This schedule of values shall be used for evaluation of pay requests. Schedule of Values to include all labor and material costs.
- E. Project Record Documents: The record documents shall be bound and consist of the following:
 - 1. Product cut sheets for all products supplied.
 - 2. Test reports for horizontal cabling.
 - 3. Test reports for backbone cabling.
 - 4. Manufacturer Warranties
 - 5. "D-Size" As-Built drawings.
- F. As-Built drawings should accurately record location of service entrance conduit, termination backboards, outlet boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 2000 or later version and on minimum "D" size reproducible paper prints.
- G. The contractor shall prepare 11" x 17" as-built serving zone drawings for each Telecommunication Room. The drawing shall be laminated, framed, and secured to the wall in the Telecom Room.

1.6 QUALITY ASSURANCE

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories or certification by other recognized laboratory, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.
- C. The Owner reserves the right to send its RCDD as a representative to inspect the job site during construction to ensure compliance with the Contract Documents.

1.7 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated telecommunications systems.
- B. Telecommunications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Project Engineer of the following:
 - 1. List of three (3) reference accounts at which similar work, both in scope and design, have been completed by the contractor with the last two (2) years.
 - 2. The credentials (current BICSI certification stamp) of the responsible RCDD must be attached to the contractor's response for evaluation by the Project Engineer.
- C. Contractor must be licensed in the State of Georgia as a Telecommunications Class or Unrestricted Class Low-Voltage Contractor (LVL).
- D. The Licensed Low-Voltage Telecommunications Contractor (LVLTC) must be based in the State of Georgia.
- E. The installation of all cable, equipment, terminations, & associated services should be performed by a company that is currently a Manufacturer's Certified Structured Cabling System installer in good standing with minimum of three (3) years of experience on similar systems.
- F. The installation company must have an RCDD on staff performing the role of Project Manager and be available for consultation and to attend project meetings.
- G. A BICSI certified installer shall be employed by the contractor and be on site as the installation manager.
- H. Installer's Qualifications:
 - 1. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.
 - 2. General electric trade staff shall not be used for the installation of the premises' distribution system cables and associated hardware.
 - 3. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years' experience in the installation of the specified copper and fiber optic cable and components.
 - 4. Installer must be a current Certified Installer and must submit the current certificate with their proposal

1.8 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate telecommunications work with that of other Sections as required to ensure that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – COPPER CONNECTIVITY SYSTEM

- A. All copper cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification by manufacturer. Acceptable copper solution manufacturers shall be the products of the following manufacturers:
 - 1. Ortronics
 - 2. Panduit
 - 3. Siemon
 - 4. Leviton
 - 5. Belden
 - 6. CommScope
- B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.2 ACCEPTABLE MANUFACTURERS – FIBER OPTIC CONNECTIVITY SYSTEM

- A. All fiber optic cables and components shall be provided and installed by manufacturer certified installers that shall provide an extended warranty of 25 years for certified installations. Manufacturer shall provide warranties and contractor shall provide documentation of certification by manufacturer. Acceptable fiber optic solution manufacturers shall be the products of the following manufacturers:
 - 1. Ortronics
 - 2. Panduit
 - 3. Siemon
 - 4. Leviton
 - 5. Belden

6. CommScope

- B. The contractor shall maintain a current status with the manufacturer, including all training requirements, for the duration of the Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel in accordance with their current contract agreement to support the 25-Year System Warranty requirements. After installation, the Contractor shall submit all documentation to support the requirements of the Warranty and to obtain said warranty on behalf of the owner. The warranty will cover the components and labor associated with the repair/replacement of any defective link within the warranty period when the defect is a valid warranty claim.

2.3 MATERIALS

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.
- E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.
- F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.1 EXAMINATION OF SURFACE CONDITIONS

- A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the Project Manager.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.2 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.
- C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.
- E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.3 ACCESS TO EQUIPMENT

- A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.4 CLEANING

- A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by telecommunications work.
- B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.5 COMPLETION

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.
- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.6 TESTING AND VERIFICATION

- A. See specific Low Voltage sections for testing parameters of sub-systems.
- B. The Contractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
- C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.
- D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the telecommunications systems, components and subsystems meet specification requirements in the "as-installed" operating environment during the "System Operation Test". Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the "System Operation Test".
- E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.
- F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of

final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

- G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Telecommunications Contractor Project Manager and submitted for approval.

END OF SECTION 270500

SECTION 270526 - GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Grounding & Bonding for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document.
- D. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Provide product data.

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - a. Furnish and install all Grounding Conductors.
 - b. Furnish and install all Grounding Lugs and Hardware.
- C. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

A. Approved Equipment Grounding Conductor manufacturer(s):

1. Southwire
2. West Penn
3. Belden

B. Approved Grounding Lug manufacturer(s):

1. Burndy
2. Thomas & Betts
3. Chatsworth Products, Inc.
4. Harger

C. Approved Grounding Busbar manufacturer(s):

1. Burndy
2. Thomas & Betts
3. Chatsworth Products, Inc.
4. Harger

2.2 GROUNDING CONDUCTORS

A. Grounding Conductor

1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
2. Jacket color shall be green. Jacketed cable shall be identified at each termination point with a wrap of green tape.

2.3 GROUNDING LUGS

A. Grounding Lugs and Hardware

1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

2.4 GROUNDING BUSBAR

- A. Busbars shall be of copper construction and shall be pre-drilled in the factory. Reference contract details for exact requirements.

PART 3 - EXECUTION

3.1 GROUNDING

- A. All equipment, racks, cabinets, enclosures, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.
- B. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA/EIA-606-A.
- C. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet following criteria:
 - 1. Local electrical codes shall be adhered to.
 - 2. The grounding/earthing system shall comply with ANSI/TIA-942 and J-STD-607-A.
 - 3. All grounding/earthing conductors shall be copper.
 - 4. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.
- D. The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

- E. Ladder racks shall be bonded per the manufacturer's installation instructions. To provide electrical continuity between ladder rack segments drill holes in rack and use a #6 AWG code cable with green/yellow stripe to jumper between segments. The jumper shall be made with 2-hole copper compression connectors terminated on both ends. Attach jumpers as required to ladder rack and then bond the entire assembly to the TGB.
- F. Equipment and racks shall be bonded in accordance with the methods prescribed in ANSI/TIA-942. To provide electrical continuity between rack elements, paint piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack. All racks shall utilize a full-length rack ground strip attached to the rear of the side rail with thread-forming screws to ensure metal-to-metal contact. Patch panels will be bonded to racks using bonding screws for racks having #12-24 equipment mounting holes.
- G. Reference low voltage drawing package for additional requirements.

3.2 IDENTIFICATION

- A. Refer to section 27 0553 for labeling details.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Pathways for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of interior telecommunications pathways and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Provide product data.

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install complete Conduit System – Reference Electrical Specifications.
 - 2. Furnish and install all Telecommunications Outlet Boxes.
 - 3. Furnish and install all Pull Boxes.
 - 4. Furnish and install complete Cable Tray System.
 - 5. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. Approved Velcro Strap manufacturer(s):

1. Panduit
2. Tyco
3. Hubbell
4. Or Approved Equal

B. Innerduct

1. Exposed innerduct shall be rated CMP (plenum), corrugated plastic equipped with pull-string or mule tape.
2. Sizes shall be 2", 1-1/4" & 1" inside diameter.
3. See Drawings for innerduct details.

2.2 PULL BOXES

- A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.
- B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.
- C. Pull boxes shall have provisions for grounding.

2.3 CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Chalfant Manufacturing Company.
 2. Cooper B-Line, Inc.
 3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
 4. GS Metals Corp.; GLOBETRAY Products.
 5. MONO-SYSTEMS, Inc.
 6. MPHusky.
 7. PW Industries.
- B. Material & Finishes - Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
 1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
 2. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, G90 (Z275) coating; with hardware galvanized according to ASTM B 633. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.
 3. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.

4. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with cadmium-plated hardware according to ASTM B 766.
- C. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations.
- D. Center-hanger supports may be used only when specifically indicated.
- E. Cable Tray Accessories:
1. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
 2. Barrier Strips: Same materials and finishes as cable tray.
 3. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- F. Warning - Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- G. Materials and fastening are specified in Division 26 Section "Electrical Identification."
- H. Source Quality Control - Perform design and production tests according to NEMA VE 1.

2.4 VELCRO STRAPS

- A. Velcro Straps
1. Cables shall be fastened to support structures with Velcro straps.
 2. Velcro straps installed in air handling spaces must be plenum rated.
 3. Plenum Velcro strap color shall be red.
 4. Use 1-inch wide Velcro to secure cables to all support structures.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Remove burrs and sharp edges from cable trays.
- C. Fasten cable tray supports to building structure.
1. Design each fastener and support to carry load indicated by seismic requirements.
 2. Place supports so that spans do not exceed maximum spans on schedules.

3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 4. Support bus assembly to prevent twisting from eccentric loading.
 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 6. Locate and install supports according to NEMA VE 1.
- D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
 - E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.
 - F. Make changes in direction and elevation using standard fittings.
 - G. Make cable tray connections using standard fittings.
 - H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
 - I. Workspace: Install cable trays with enough space to permit access for installing cables.
 - J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
 - K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.2 CABLE INSTALLATION

- A. Install cables only when cable tray installation has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

3.3 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.
- B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 - 1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 - 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 - 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

- B. Report results in writing.

3.5 PROTECTION

- A. Protect installed cable trays.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
 - 3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

3.6 PENETRATIONS

- A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.

- B. Holes shall be located so as not to affect structural sections such as ribs or beams.

- C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.
- D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.
- E. All penetrations where conduit is not used shall be sleeved.
- F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.7 CONDUIT SYSTEM

- A. All conduit shall not be less than 3/4" trade size.
- B. No more than two 90 degree sweep bends or the equivalent shall be permitted between junction boxes, pull boxes, cabinets, or cable access points.
- C. Conduit shall be provided as a continuous run perpendicular from the cable tray to the work area outlet. All cables shall be enclosed in conduit or cable tray for protection.
- D. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.
- E. Leave all empty conduits with a 200 pound test nylon cord pull line.
- F. A 200 pound test nylon cord pull line shall be co-installed with all cable installed in any conduit.
- G. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
- H. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
- I. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
- J. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
- K. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
- L. Where conduits must pass through structural members obtain approval of Architect.

- M. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
- N. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
- O. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas. PVC to be installed below concrete in grade. Contractor to utilize Rigid Galvanized Steel (RGS) elbows for all slab penetrations and stub-ups.
- P. Telecommunications cables shall not occupy conduits with power cables.
- Q. Metallic conduits shall be grounded in accordance with J-STD-607-A.
- R. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
- S. Conduit runs shall not have more than two (2) 90-degree bends between pull points.
- T. Telecommunications conduit system shall contain no condulets (also known as an LB).
- U. Horizontal Conduits
 - 1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3.8 TELECOMMUNICATIONS OUTLET BOXES

- A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.
- B. The approximate locations of the outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.
- C. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.
- D. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.
- E. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold it secure to the wall.

- F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.9 PULL BOXES

- A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.
- B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.
- C. Pull boxes shall be free from burrs, dirt and debris.
- D. Pull boxes shall be installed in accordance with ANSI/TIA/EIA-569-A.
- E. Pull boxes shall be grounded in accordance with J-STD-607-A.

3.10 CABLE TRAY SYSTEM

- A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.
- B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.
- C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.
- D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.
- E. Install cable tray level and straight.
- F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.
- G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.
- H. Cable tray system shall be grounded in accordance with J-STD-607-A.
- I. Bundle horizontal distribution cables in groups not greater than 50 cables.

3.11 VELCRO STRAPS

- A. Velcro straps shall be installed around cables at intervals of 12" minimum.
- B. Do not over-cinch cables.

3.12 IDENTIFICATION

- A. Refer to section 27 05 53 for labeling details.

END OF SECTION 270528

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the equipment and execution requirements relating to Administration & Labeling for Communications Systems.
- C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Provide the following submittals:
 - 1. Product data
 - 2. Product samples
 - 3. Label sample showing example and text size for each item
 - 4. Software program sample

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Perform all Labeling.

PART 2 - PRODUCTS

2.1 LABELS

- A. All labels shall be vinyl.

- B. All labels shall have an adhesive backing for permanent attachment.
- C. All labels shall be of sufficient size. Minimum sizes shall be as follows:
 - 1. 1-1/2"W x 3/16"H for:
 - a. Outlets
 - b. Outlet cables
 - c. Patch panels
 - d. Ground wires
 - e. Backbone cable pairs
 - 2. 4"W x 1"H for:
 - a. Backbone cables
 - b. Equipment racks
 - c. MDF frames
 - d. Active hardware and multiplexers
 - 3. 3" Square Tag mechanically stamped, legible, and permanent affixed. Tag shall be copper, brass, or 1/16" plastic.
 - a. Cable Tray
 - b. Riser Backbone Conduits
 - c. Backbone Conduits

2.2 LABEL HOLDERS

- A. Labels attached to backbone cable bundles shall be installed on a label holder of sufficient size. Label holder to be plastic and have tie wrapping provisions.

2.3 SOFTWARE PROGRAM

- A. Software program shall be of the following types or similar:
 - 1. PANDUIT labeling program
 - 2. Brady labeling program
 - 3. Thomas & Betts labeling program
 - 4. Excel, customized

2.4 TEMPORARY LABELS

- A. Vinyl labels, hand written, with permanent marker.

2.5 CHARTS

- A. Provide printed charts containing required punch down and cross-connect information. Charts to be computer generated. File information shall be turned over to owner in printed and electronic format four (4) weeks prior to job completion.

2.6 AS-BUILT PLAN

- A. Description: At the completion of the project, provide an "as-built" floor plan of each floor to the Project Engineer for approval.

PART 3 - EXECUTION

3.1 LABELING REQUIREMENTS

- A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA/EIA-606 document, manufacturer's recommendations and best industry practices.
- B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.
- C. All labels shall be clear with black text.
- D. All cables shall be labeled with machine generated, wrap around labels.
- E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet; 12" from termination block/patch panel.
- F. Labeling scheme shall be alphanumeric.
- G. Provide and generate all labeling (no labels will be furnished by the owner).
- H. Labels shall be developed and printed using a software program.
- I. Software program and all in-puts shall be turned over to the owner at the end of the project.

3.2 INSTALLATION

- A. All labels shall be installed straight.
- B. Provide labels at locations as indicated on the Drawings and as follows:
 - 1. Outlet face plates
 - 2. Inside of outlet boxes
 - 3. Outlet cable inside box

4. Outlet cable in ceiling above outlet
5. Outlet cables at poke through entrance on both sides
6. Outlet cable at rear of patch panel.
7. Port at rear of patch panel
8. Port on front of patch panel
9. Individual fiber strands at rear of patch panel
10. Backbone cables & conduits whenever exposed on minimum 10' intervals
11. Backbone cable & conduit at point of termination
12. Ends of any cored cable put in place that is not terminated
13. On front of racks, cabinets frames, active hardware, multiplexers
14. Cable tray.

3.3 LABELING SCHEME

A. In general the following items shall receive labeling:

1. Outlets:
 - a. Top Label: Present Room–Telecom Room–Box Designation in Room. Ex: 112-119-3
 - b. Bottom Label: Port Designation: D=Data Jack; T=Voice Jack – Ex. D1, D2, T1
2. Outlet cables
3. Backbone cables - (CVR=139) copper backbone to room 139, 1-25, 26-50, 51-75, etc - 200)
4. Patch panels - (ex. PP#1, PP#2, etc)
5. Patch panel ports (each) - Station room #, Box Designation in Room, Port Designation in Room. Ex – 112-3-4. Note – If Telecom Room serves 100 jacks, labels would start at 001 and go to 100.
6. Equipment racks and cabinets - (EX. Rack 1, rack 2, etc)
7. Ground wires
8. Active hardware and multiplexers (by owner)

Note – Contractor to obtain approval from owner/engineer before beginning labeling task.

B. Patch Panel labeling strip colors:

1. Voice patch panels shall have port labels in “light blue” strips.
2. Data patch panels shall have port labels in yellow” strips.

3.4 TEMPORARY LABELS

A. Provide temporary labels on all outlet cable as it is roughed-in. The bid documents will not show outlet/cable labeling at the time of the cable rough-in. Replace temporary labels with permanent labels after contract documents have been revised.

3.5 TEXT SIZE AND INFORMATION

- A. Text size should be as large and as bold as possible.
- B. Exact text required information is shown on the Drawings.
- C. Refer to Drawings for all outlet, outlet cables, and backbone cables labels.
- D. Refer to the Cover Drawing for exact labeling coding schemes, where applicable.

3.6 LABELING AND REFERENCE CHARTS

- A. Contractor to provide a labeling reference chart(s) indicating the following:
 - 1. Backbone termination of pairs at the local telecommunication room (TR) and main telecommunications room (MR).
 - 2. Horizontal outlet cable pair termination at the TR.
 - 3. Data patch panel outlet port termination.

3.7 AS-BUILT PLAN & FRAME

- A. Provide and mount frame with "as-built" on TR wall near the data racks, or as indicated on the plans.

END OF SECTION 270553

SECTION 270800 - COMMISSIONING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the equipment and execution requirements relating to Commissioning of Communications.
- C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Perform all Copper Cabling Testing.
 - 2. Provide all Documentation, As-Builts, Training and Warranty.

PART 2 - TESTING

2.1 TESTING REQUIREMENTS

- A. General
 - 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B.1-3. All pairs/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.

- B. Copper Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 performance. Horizontal balanced twisted pair cabling shall be tested using a level III test unit for category 6 compliance (data) and category 6 compliance (voice) and performance up to 350 MHz
2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1-3 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.
2. Test set-up and performance shall be conducted in accordance with ANSI/TIA/EIA-526-7 and/or ANSI/TIA/EIA-526-14 Standards, and to the manufacturer's application guides.
3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
4. Multimode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB.
5. Singlemode - Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter / light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB.

D. Test Results

1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used

- and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B.1-3.
 3. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. Alternately, the contractor may furnish this information in electronic form (CD). These diskettes or CDs shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable from Microsoft Word.
 4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 - DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.1 DOCUMENTATION & AS-BUILTS

- A. As-Built record documentation for telecommunications work shall include:
1. Cable routing and identification
 2. System function diagrams
 3. Manufacturers' description literature for equipment
 4. Connection and programming schedules as appropriate
 5. Equipment material list including quantities
 6. Spare parts list with quantities
 7. Details not on original Contract Documents
 8. Test Results
 9. Warranties
 10. Release of Liens
- B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract Drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.
- C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of Telecommunications infrastructure work.
- D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.
- E. Furnish as-built drawings and documentation to the Project Engineer for review and approval. As-built drawings shall be generated in AutoCad 2018 or later. Submit as-built drawings electronically on C.D. and hard copy.

3.2 OPERATIONS AND MAINTENANCE MANUAL

- A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.
- B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate specification sections.
- C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
 - 1. Operations manuals for components and for systems as a whole.
 - 2. Maintenance manuals for components and for system as a whole.
 - 3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details.
 - 4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
 - 5. Emergency instructions for operational and maintenance requirements.
 - 6. Delivery time frame for replacement of component parts from suppliers.
 - 7. Recommended inspection schedule and procedures for components and for system as a whole.
 - 8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
 - 9. Complete "Reviewed" shop drawings and product data for components and system as a whole.
 - 10. Troubleshooting procedures for each system and for each major system component.

3.3 TRAINING

- A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.4 WARRANTY

- A. General
 - 1. All equipment is to be new and warranted free of faulty workmanship and damage.
 - 2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the owner.

3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Horizontal Structured Cabling

1. Low voltage contractor shall provide a 25-year manufacturer warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Pathway & Support Infrastructure

1. Manufacturer(s) shall provide a 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION 270800

SECTION 271100 - EQUIPMENT ROOM COMPONENTS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Cabinets, Racks & Enclosures.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Provide product data.

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install all Equipment Racks.
 - 2. Furnish and install all Equipment Cabinets.
 - 3. Furnish and install all Equipment Shelves.
 - 4. Furnish and install all Backboards.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. Approved Equipment Rack manufacturer(s):

- 1. Panduit

2. Middle Atlantic
3. CPI

B. Equipment Racks

1. The equipment rack shall be constructed of high strength, lightweight aluminum.
2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
3. Rack shall be: 7' tall, standard 19" width floor mounted or wall mount racks, as required by contract documents.
4. Racks shall provide a minimum 20" interior depth for rack mount equipment and front mount cable management.
5. Floor mount equipment racks and cabinets shall be provided with adjustable height leveling feet or casters.

C. Cable Guides

1. Between patch panels with front & back channels – minimum size of 2u
2. At ends of racks and between racks with front & back channels – Minimum size 6" at ends and 12" wide between racks

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS/CABINETS/SHELVES

- A. Where mounted to structure, equipment racks shall be securely attached to the floor or structural wall using four (4) 1/2" diameter bolts and associated hardware (anchors & washers) or as required by local codes.
- B. Wall mounted equipment racks shall be provided with fire rated plywood backboard for additional mounting support. Backboard shall be mechanically fastened to CMU wall or framing stud. It shall not be acceptable to support wall mount equipment racks using only drywall or gypsum board.
- C. Equipment racks/cabinets/shelves shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- D. Equipment racks/cabinets shall be placed with a minimum clearance of 30 inches in the front and 30 inches in the rear or as indicated on Drawings.
- E. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.
- F. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

3.2 BACKBOARDS

- A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 8' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint (Additive Acceptable).

3.3 IDENTIFICATION

- A. Refer to section 27 05 53 for labeling details.

END OF SECTION 271100

SECTION 271123 - CABLE MANAGEMENT & LADDER RACK

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Cable Management & Ladder Rack.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this specification.

1.2 SUBMITTALS

- A. Product data.

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install all Horizontal Cable Management.
 - 2. Furnish and install all Vertical Cable Management.
 - 3. Furnish and install Ladder Rack System.
 - 4. Furnish and install all Velcro Straps.

PART 2 - PRODUCTS

2.1 CABLE MANAGEMENT – HORIZONTAL

- A. Horizontal Cable Management

1. The horizontal wire manager shall be compatible with 19-inch equipment racks and cabinets.
2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
3. The horizontal wire manager shall be equipped with management fingers and covers.
4. The horizontal cable manager shall be 2 rack-units in height and shall be 2-sided.

2.2 CABLE MANAGEMENT – VERTICAL

A. Vertical Cable Management

1. The vertical cable manger shall be double-sided.
2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
3. The vertical cable manager shall be a minimum width of 6" & 12".
 - a. Vertical Cable Manager color shall be black.

2.3 TELECOM ROOM LADDER RACKS

A. Ladder Rack System

1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
 - a. Ladder Rack System color shall be black.
4. Acceptable Manufacturers include:
 - a. Hoffman
 - b. Chatsworth

2.4 VELCRO STRAPS

A. Velcro Straps

1. All cables shall be fastened to support structures with Velcro straps.
 - a. Velcro Strap color shall be black.

2.5 LADDER RACK DROP-OUT SHIELD

A. Ladder Rack Drop-Out Shield

1. Ladder rack drop-out shields shall be required to protect cables as they are routed from ladder rack to all vertical wire managers on equipment racks.

B. Acceptable Manufacturers & Products include:

1. Hoffman #LRD12BLK or LSRDBLK
2. Chatsworth #12100-712 or 12100-701

PART 3 - EXECUTION

3.1 CABLE MANAGEMENT – HORIZONTAL

- A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) or as indicated on Drawings.

3.2 CABLE MANAGEMENT – VERTICAL

- A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.3 LADDER RACKS

- A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.
- B. Ladder racks shall be supported at 5' intervals maximum.
- C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.
- D. See Drawings for ladder rack system details.

3.4 VELCRO STRAPS

- A. Velcro straps shall be installed around cables at intervals of 12" minimum.
- B. Do not over-cinch cables.

3.5 LADDER RACK DROP-OUT SHIELD

- A. Install in ladder rack above equipment racks to support cables as they are routed from the ladder rack to the equipment rack.

3.6 IDENTIFICATION

- A. Refer to section 27 05 53 for labeling details.

END OF SECTION 271123

SECTION 271126 - COMMUNICATIONS RACK MOUNTED POWER STRIPS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Rack Mounted Power Strips.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.
- D. Provide one (1) power strip for each equipment rack. See rack elevation drawings.

1.2 SUBMITTALS

- A. Provide product data

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install all Power Strips.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. Approved Power Strip manufacturer(s):
 - 1. Chatsworth Products, Inc.
 - 2. Ditek

3. Geist
4. ITW Linx

2.2 POWER STRIPS

A. Power Strip

1. The power strip shall be equipped with a minimum of six (6) 3-prong, 120 VAC outlets, 6' cord and an on/off switch. Outlets shall accept side pole neutral plugs.
2. The power strip shall be equipped with surge protection with a 20 Amp current limit.
3. The power strip shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

PART 3 - EXECUTION

3.1 POWER STRIPS

- A. Power strips shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- B. See Drawings for installation location on rack(s)/cabinet(s).

3.2 IDENTIFICATION

- A. Refer to section 27 05 53 for labeling details.

END OF SECTION 271126

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. Cable connecting hardware, patch panels, and cross-connects.
 - 4. Cabling identification products.

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 Telecommunications rooms in the telecommunications cabling system structures. Cabling system consists of backbone cables, intermediate and main cross-connects mechanical terminations, and patch cables or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects shall be located in Telecommunications rooms. 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 ANSI/TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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. Cabling diagrams to show typical cabling schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cables.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Ladder rack layout, showing ladder rack route to scale, with relationship between the rack and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of ladder racks.
 - c. Vertical elevation of ladder racks above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for rack and its support elements.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.
- G. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 2. Test each pair of UTP cable for open and short circuits.

1.9 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. Polyvinyl floor tile shall be in place prior to mounting systems to the floor.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's Representatives and University.

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. Patch-Panel Units: 10% of each type.
 - 2. Connectors and covers: 10% of each type.

PART 2 - PRODUCTS

3.1 Fiber Optic Cable

- A. Multi-Strand Multi-mode Mode: (See one-line diagrams for quantities)
 - 1. Multi-mode fiber shall be 50/125 micron
 - 2. Manufacturer shall provide 25 year warranty.
 - 3. Maximum Single mode cable attenuation dB/km @ 1310nm/1550nm : 0.65/0.50
- B. Multi-Strand Single Mode: (See one-line diagram for quantities)
 - 1. Single mode fiber shall be 8.3/125 micron
 - 2. Shall be tight buffered construction.
 - 3. Manufacturer shall provide 25 year warranty.
 - 4. Maximum Single mode cable attenuation dB/km @ 1310nm/1550nm : 0.65/0.50.
- C. Multi-Strand OSP Single Mode: (See one-line diagram for quantities)
 - 1. Single mode fiber shall be 8.3/125 micron
 - 2. Shall be loose tube construction.
 - 3. Shall be fully water blocked and gel free .
 - 4. Manufacturer shall provide 25 year warranty.
 - 5. Maximum Single mode cable attenuation dB/km @ 1310nm/1550nm : 0.65/0.50.

3.2 OPTICAL FIBER CONNECTORS

- A. Single mode Fiber Optic Connectivity:
 - 1. The optical fiber field-installable connector shall be LC format, for installation onto single mode 8.3/125-micron fiber.
 - 2. Only fusion spliced pigtails are acceptable.
 - 3. The optical fiber field-installable connector shall have a maximum Loss of .15 dB.
- B. Multi-mode Fiber Optic Connectivity:
 - 1. The optical fiber field-installable connector shall be LC format, for installation onto multi-mode 50/125-micron fiber.
 - 2. Only epoxy connectors are acceptable.
 - 3. The optical fiber field-installable connector shall have a maximum Loss of .3 dB.

3.3 OPTICAL FIBER TERMINATION UNITS

- A. Termination units shall rack mounted fiber optic enclosures designed to manage and organize fiber optic cables.
- B. Enclosures shall accommodate up to 36 fibers with LC connector packs.

- C. Enclosures shall have front and rear removable covers and top and bottom pass through holes.

3.4 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.

3.5 SOURCE QUALITY CONTROL

- A. Factory test cables on reels according to ANSI/TIA/EIA-568-B.1.
- B. Factory test UTP cables according to ANSI/TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 4 - EXECUTION

5.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service entrance facilities provider.

5.2 CABING METHODS

- A. Cabling Method: Install cables in raceways and ladder racks except within equipment racks and cabinets. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Division 27.
- B. Cabling Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Cabling 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.

5.3 INSTALLATION OF CABLES

- A. Comply with NECA 1
- B. General Requirements for Cabling:

1. Comply with ANSI/TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
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. Use 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. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 25-foot- long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Comply with the State of Georgia Telecommunications Design Manual.

C. UTP Cable Installation:

1. Comply with ANSI/TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
3. Do not remove more than 1/2 inch of the outer jacket.

D. Optical Fiber Cable Installation:

1. Comply with ANSI/TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and ANSI/TIA/EIA-569-B 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.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
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.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
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.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 12 inches.

5.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Through-Penetration Firestop Systems." Comply with ANSI/TIA/EIA-569-B, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

5.5 IDENTIFICATION

- A. Identify system components, cabling, and cabling complying with ANSI/TIA/EIA-606-A. Comply with requirements for identification specified.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about ANSI/TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with ANSI/TIA/EIA-606-A.
- C. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- D. Cable Schedule: Install in a prominent location in each equipment room and cabling 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.

- E. 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, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- F. Cable and Wire Identification:
 - 1. Label each cable within 6 inches 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. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number cabling conductors connected to terminal strips and identify each cable or cabling group being extended from a panel or cabinet to a building-mounted device with name and number of particular devices as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 4. Identification within Connector Fields in Equipment Rooms and Cabling Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- G. 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 ANSI/TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

5.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 ANSI/TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cables, and labeling of 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 ANSI/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 cables and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

- C. 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.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

5.7 WARRANTY

- A. The Structured Cabling System shall carry a manufacturer's 25 year product, labor and applications assurance warranty. Manufacturer and University shall perform an end-to-end audit on infrastructure prior to releasing warranty.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Structured Communications Copper Horizontal Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Contractor shall provide submittals indicating the following:
 - 1. Cable description
 - 2. Use of cable
 - 3. Product data
 - 4. Specifications outlining cable
 - 5. Testing and qualification data
 - 6. Samples, approximately 12” in length

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install all Horizontal Copper Cable.

PART 2 - PRODUCTS

2.1 HORIZONTAL DATA, VOICE, & WIRELESS DATA COPPER CABLE

A. CATEGORY 6 BALANCED TWISTED PAIR CABLE – VOICE & DATA

1. Description: 100-ohm, 4-pair UTP, 350 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
 - a. Comply with ICEA S-90-661 for mechanical properties.
 - b. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
 - c. Comply with ANSI/TIA/EIA-568-B.2, Category 6.
 - d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

B. CATEGORY 6A BALANCED TWISTED PAIR CABLE – WIRELESS DATA

1. Description: 100-ohm, 4-pair UTP, 500 MHz certified cable, covered with a Blue thermoplastic jacket or as directed by the Owner Representative.
 - a. Comply with ICEA S-90-661 for mechanical properties.
 - b. Comply with ANSI/TIA/EIA-568-C.1 for performance specifications.
 - c. Comply with ANSI/TIA/EIA-568-C.2, Category 6A.
 - d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types: Communications, Plenum Rated: Type CMP.

2.2 COPPER PATCH CABLES

- A. Provide one patch cable for each terminated Category 6 and Category 6A cable.
- B. 50% of patch cables shall be approximately 2 meters in length, 25% of patch cables shall be approximately 3 meters in length, and 25% of patch cables shall be approximately 1 meters in length. Cable used for the construction of patch cables shall be UL or ETL verified to meet Category 6 and Category 6A requirements and the cable jacket shall be labeled to indicate verification.
- C. Patch cords shall be color coded by system type to match the Owner's requirements. Basis of design shall be as follows:
 1. Data Communications:: Blue
 2. Voice Communications: Electric Ivory
 3. Wifi Communications: Green
- D. Provide the following:
 1. One RJ45 to RJ45 jacketed Cat 6 patch cable for each data patch panel port.
 2. One RJ45 to RJ45 jacketed Cat 6A patch cable for each white wireless data patch panel port.

3. For all voice services, provide ten (10) 3-meter hybrid patch cords. Patch cords to be RJ-45 to 2-pin straight connector.
4. One set of two factory made fiber patch cords of a length and type to be specified by the owner (typically 3 meter Single Mode and Multimode SC-LC) for each fiber run.
5. Three (3) 500' spools of pair one, 24AWG, cross connect wire for the entire project.

PART 3 - EXECUTION

3.1 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-A maximum fill for the particular raceway type.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- G. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- H. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- I. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- J. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- K. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.2 document, manufacturer's recommendations and best industry practices.
- L. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall

installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

- M. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- N. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support straps. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- O. When creating service loops for copper cables, they should be coiled in a Figure-eight configuration to eliminate adding to the problems of Return Loss and NEXT.

3.2 IDENTIFICATION

- A. Refer to section 27 05 53 for labeling details.

END OF SECTION 271500

SECTION 271543 - FACEPLATES & CONNECTORS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Faceplates & Connectors.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of horizontal cabling and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

1.2 SUBMITTALS

- A. Provide the following submittals:
 - 1. Product data
 - 2. Sample of each outlet correctly configured.

1.3 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install all Copper Connectivity.
 - 2. Furnish and install all Faceplates.
 - 3. Furnish and install all Surface Mount Boxes.

PART 2 - PRODUCTS

2.1 COPPER CONNECTIVITY

- A. Horizontal Module

1. The horizontal module shall accommodate up to four (4) Category 6, 8-position, 8-contact modular jacks.
 - a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-2 Category 6 pair-to-pair NEXT performance specifications.
 - b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
 - c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
 - d. Each jack shall be T568B wiring configuration.
 - e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
 - f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design for color codes shall be as follows:
 - 1) Faceplates and Blanks: Electric Ivory
 - 2) Telephone Communications: Electric Ivory
 - 3) Data Communications: Blue
 - 4) Wifi Communication: Green
2. For Category 6A wireless access point circuits, the horizontal module shall accommodate up to four (4) Category 6A, 8-position, 8-contact modular jacks.
 - a. Each jack shall be power sum rated, with a power sum NEXT performance equal to or better than the ANSI/TIA/EIA-568-C-1 Category 6A pair-to-pair NEXT performance specifications.
 - b. Each jack shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
 - c. The connector module shall be designed for use at the Work Area, Telecommunications Room and/or Equipment Room without modification.
 - d. Each jack shall be T568B wiring configuration.
 - e. Each jack shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
 - f. Jack colors shall be confirmed by the owner. Unique jack colors shall be required for voice, data, spare and wireless access point outlets. Basis of design shall be Electric Ivory.

B. F-connectors shall be By Thomas & Betts and of the “Snap N Seal” type model.

2.2 FACEPLATES

A. Faceplates – Straight-Type

1. The faceplate housing the connector modules shall have no visible mounting screws.
2. It shall be possible to install the connector modules in wall-mounted single-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.

3. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
4. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows to facilitate outlet identification and ease network management.
5. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network needs.
6. Blank inserts shall be used on faceplates for all unused ports.
7. Basis of design shall be Panduit CFPL4EIY with CMBEI-C blank modules.

2.3 SURFACE MOUNT BOXES

- A. The surface mount box shall accommodate horizontal and video connections.
- B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.
- C. Color shall be Electric Ivory.

PART 3 - EXECUTION

3.1 COPPER CONNECTIVITY

- A. 8-position, 8-contact modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

3.2 FACEPLATES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
- C. Faceplates shall be installed straight and level.
- D. Faceplates shall be installed at heights as noted on the Drawings.

3.3 SURFACE MOUNT BOXES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

- C. Surface mount boxes shall be installed straight and level.
- D. Surface mount shall be installed at heights as noted on the Drawings.

3.4 IDENTIFICATION

- A. Refer to section 27 0553 for labeling details.

END OF SECTION 271543

SECTION 274116 – INTEGRATED AV COMMUNICATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. This specification outlines Presentation Systems Contractor (PSC) requirements to furnish and install presentation systems and all low-voltage wiring required for completely operational systems in the College of Coastal Georgia project. All necessary infrastructure shall be required and provided by the PSC for a completely operational audio-visual presentation system inclusive of sound, display, distribution, control, lighting, and rigging. A separate bid for all work required in conjunction with the stated A/V package for a complete and functioning electrical packing will be required.
- B. The systems shall not be considered complete until as-built documentation, final system commissioning, and facility personnel training are completed. This facet of the services to be provided by the PSC is deemed very important to the satisfactory completion of the contract. To that end, a final payment reserve of 10% of the system purchase price shall be held from payment until the documentation package and training described in Part III are delivered.
- C. Systems are described by the drawings and equipment product list.

1.2 RELATED SECTIONS

- A. Architectural
- B. Electrical
- C. Fire Protection
- D. Mechanical

1.3 INTENT AND INTERPRETATIONS

- A. It is the intent of the Construction Documents that the PSC shall include all items necessary for the proper execution and completion of the project, resulting in the complete and fully operational system(s) ready for the Owner's use, in full compliance with all applicable standards, codes, and ordinances.
 - 1. Work or products not specifically indicated in the Construction Documents but which are necessary to result in complete and fully operational system(s) ready for the Owner's use shall be provided by the PSC.
 - 2. The specification of certain products in the Construction Documents shall not be construed as a release from furnishing such additional products and materials necessary to furnish complete and fully operational system(s) ready for the Owner's use.
- B. In the event that discrepancies exist or required items or details have been omitted in the Construction Documents, the PSC shall notify the Owner/Consultant in writing ten (10) days prior to the bid date. Failure to do so shall be construed as a willingness to provide a complete and fully operational system within the amount bid by the PSC. Where such discrepancies are not brought to the attention of the Owner/Consultant, the most stringent (costly) requirements shall be construed to be the basis for the PSC's bid.

- C. Drawings and Specifications are complementary. Items required by either are binding as though they are required by both. In the event of a conflict between the requirements of the Drawings and the Specifications:
 - 1. The specifications and drawings provide an intent of the type of systems required. Any item not addressed by these documents but typically required shall be part of the PSC's work.
 - 2. With regards to the preparation of proposals and/or bids, the PSC shall assume the more stringent (costly) condition shall prevail. The PSC shall notify the Owner/Consultant of such a minimum of ten (10) days prior to the bid date.
 - 3. With regards to actual construction, the PSC shall notify the Owner/Consultant and await the Owner's/Consultant's instruction prior to proceeding with procurement and installation.
- D. Drawings:
 - 1. Drawings are diagrammatic and approximate in character, are not intended to show all features of required work, and do not necessarily indicate every required component.
 - 2. Symbols used on the Drawings are defined in the legend on the Drawings. Symbols indicated on the legend may not necessarily be required.

1.4 DEFINITIONS

- A. The term "Contractor", "Supplier", or "Presentation Systems Contractor (PSC)" as used herein refers to the party responsible for supplying all services and equipment covered herein and on related drawings.
- B. The term "Owner" shall refer to the College of Coastal Georgia.
- C. The term "Consultant" shall refer to the consultant who is responsible for the design of the audio, video, and control systems.
- D. The term "Electrical Contractor" shall refer to the Division 26 contractor.
- E. The term "provide" will mean to supply, install, verify performance, and coordinate interconnection and power.
- F. Specialized terms particular to technical systems and related work shall be used in the following manner, in accordance with:
 - 1. Captions on related drawings.
 - 2. Generally recognized audio engineering and production usage.
 - 3. Relevant usage and definitions of handbooks, guidebooks, or trade group recommendations by manufacturers' associations or professional and engineering societies such as SMPTE, ICIA, UL, and NEMA.

1.5 RELATED DOCUMENTS

- A. The PSC shall read, review, and understand all documents listed below prior to bidding or proceeding with work. The PSC shall also refer to and understand all other related documents indicated herein. Failure to familiarize itself with the construction documents will not relieve the PSC of its responsibility to complete the work in accordance with the construction documents.
- B. Division 1: Applicable provisions of Division 1 shall govern all work under this section.
- C. Contract: In addition to the conditions and work described herein, all conditions of the Contract shall apply.

D. Presentation System Drawings:

1. AV001 LEGEND
2. AV101 AUDITORIUM FLOOR PLAN
3. AV201 AUDITORIUM LIGHTING RCP
4. AV202 AUDITORIUM AV RCP
5. AV301 AUDITORIUM SECTION
6. AV401 ENLARGED CONTROL BOOTH LAYOUT
7. AV402 AUDITORIUM CURTAIN LAYOUT
8. AV501 PLATE DETAILS
9. AV502 FLOOR BOX DETAILS
10. AV503 AUDIO DETAILS
11. AV504 AUDITORIUM VIDEO DETAILS
12. AV505 DISTRIBUTED VIDEO DETAILS
13. AV506 PRODUCTION LIGHTING DETAILS
14. AV507 DIMMER SCHEDULE
15. AV508 EQUIPMENT RACK DETAILS
16. AV509 COMPANY SWITCH DETAILS
17. AV601 AUDIO FLOW DIAGRAM 1
18. AV602 AUDIO FLOW DIAGRAM 2
19. AV603 VIDEO FLOW DIAGRAM
20. AV604 LIGHTING FLOW DIAGRAM

1.6 DESCRIPTION OF SYSTEM

A. AUDITORIUM – AUDIO

1. The auditorium shall be equipped to support presentations and productions with high-quality speech amplification, performance instruments of all types, program material content playback, and presentation audio for video playback. There will be 2 primary operational modes of the sound system. The first mode will be the *Production Mode*. In this mode, primarily for theatrical productions or band/concert performances, the operator will have constant hands-on manual control of the mix and levels. The second mode will be the *Presentation Mode*. In this mode, the audio levels from the laptop or other presenter's content and the presenter's microphone level will be controlled from the control system's touch panel. This system operates independently from the production equipment. In the event there is a fire alarm instance, the sound system shall mute. Coordination with the fire alarm contractor is key to obtain a contact closure or other signal to engage the audio system accordingly.
2. The main house PA speaker system will consist of a left, center, and right loudspeaker system with subwoofers. In addition, there will be delay speakers suspended for coverage in the rear of the house.
3. The main mixing console shall have a minimum of 48 mono and 2 stereo input channels for mixing.
4. *Production* – There shall be 10 wireless microphone channels.
5. *Presentation* – There shall be 1 dedicated wireless hand-held system for presentations.

6. The configuration shall consist of main loudspeakers, delay fill loudspeakers, and subwoofers. Programmed settings such as equalization, limiting, and delay in the DSP shall be done to keep the final room tuning settings away from normal operation and operators and shall be password protected.
7. There shall be audio inputs and outputs available on stage. There will be floor boxes downstage, as detailed on the drawings. There shall be 2 discreet monitor mix feeds for floor wedges, side fills, or passive hotspots. Distribute the monitor mix outputs to I/O plates around the stage and floor boxes according to drawings.
8. There shall be an RF-based assisted listening system. The appropriate number of receivers shall be included in accordance with ADA regulations. Receivers shall have the ability to transmit audio through a T-coil lanyard for hearing aids and conventional earphones as well.
9. There shall be a distributed audio background system. This system will serve the lobby, dressing room, and green rooms.
10. A 2-channel production analog intercom system shall provide comfortable, intelligible communication between the various technicians, stage manager, and crew. Speaker stations will be located in various locations per the drawings. The main station will be in the control booth's equipment rack. In addition to these intercom locations, there shall be intercom drops at various locations in the venue.

B. AUDITORIUM – VIDEO

1. The auditorium shall be equipped to support lectures and productions with high-definition imaging of computer and media playback sources.
2. The projector shall be mounted on the upstage wall and projected to a rear screen.
3. The projector shall have a laser light engine with a minimum brightness of 20,000 lumens.
4. There shall be a multi-format presentation switcher/matrix mounted in the equipment rack.
5. The projection screen shall be electric with an aspect ratio of 16:10
6. There shall be a high-definition camera mounted in the back of the room to provide a video feed for backstage monitors, recording, or future streaming.
7. There shall be a PTZ camera mounted on the rear wall. The image will feed LCD monitors in areas such as the lobby, green room, dressing rooms, etc. See appropriate drawings to determine locations. It shall also provide the means to record and stream presentations or productions in the auditorium in the future.
8. There shall be a digital signage player that will feed the RF system for viewing messages and program material on various displays.

C. AUDITORIUM – CONTROL SYSTEM

1. The remote-control system shall provide integration and control of key components using wired touch panels. Programming shall focus on the operation of the presentation system, ranging from simple podium events to manual-operated productions. The menu shall include, but not be limited to, the following.
 - a. Presentation or Production Mode
 - b. Lighting pre-set recall
 - 1) Contractor to provide 6 lighting presets per the owner's guidance.
 - c. System power cycle screen
 - 1) All AV
 - 2) Projector Power

- 3) Screen Control
- d. A/V switcher screen
 - 1) Source selection
 - a) Laptop
 - b) Booth Sources
 - c) Stage Video
 - d) Stage Audio (MP3/CD)
 - 2) Source audio volume in presentation mode
- 2. PTZ camera control
- 3. Media player commands
 - a. Blu-ray transport commands and menu functions

D. AUDITORIUM – LIGHTING

1. The auditorium shall be equipped with a state-of-the-art lighting system to support theatrical productions, projection presentations, video recording, and presenter meetings.
2. The lighting console and dimming system shall be used to control the theatrical lights and the architectural house lights in and around the auditorium area.
3. All theatrical fixtures shall be LED and be supplied complete with safety cable, c-clamp, lenses, DMX/power cables, and extension cables as needed.
4. Theatrical Lighting fixtures are to be LED-type controlled with constant power and DMX. Lighting fixtures are mounted on the pipe grid and connected to power and DMX positions.
5. Production events are to be controlled by a full programable theatrical lighting console
6. The Contractor is responsible for programming the following production scenes for initial commissioning.
 - a. Full-stage wash
 - b. Podium or Presentation Event
 - c. House lights and presets for remote control system to recall
 - d. Owner specified #1

E. DRESSING ROOM / GREEN ROOM

1. The room shall be equipped to support presentations with high-quality amplification of program content playback and presentation audio for video playback.
2. Ceiling-mounted loudspeakers shall provide sound reinforcement for the designated area.
3. A wall-mounted button controller shall control the room system.

F. CONCESSIONS / LOBBY

1. The room shall be equipped to support presentations with high-quality amplification of program content playback and presentation audio for video playback.
2. A typical signage location will have a suitably sized LED flat panel display mounted according to the location and a small media signage player.
3. Pendant and ceiling-mounted loudspeakers shall provide sound reinforcement for the designated area.

1.7 ALTERNATES

A. No Add Alts

1.8 SCOPE OF WORK

A. Work Included

1. Provide all labor and material for the complete installation of the presentation systems as hereafter specified and shown.
2. PSC shall review the entire project package, including drawings and notes for other trades that may impact the Presentation Systems work, and make provision for such.
3. Equipment shall be new, current production, with original warranty. Demo, refurbished, used, or B-stock equipment shall not be acceptable.
4. Quantities are listed for reference only. It is the PSC's responsibility to verify the quantities of all components.
5. All equipment must be installed in a neat and orderly fashion by competent workmen according to the manufacturer's instructions.
6. All system components shall be completely prewired, with all field connections clearly labeled. All equipment shall be UL and/or CE listed and comply with the National Electrical Code or equivalent authority and all applicable regulations of serving utilities and governmental bodies having jurisdiction.
7. Presentation equipment shall not be stored at the job site. Equipment shall be moved to the job site from a conditioned space only when scheduled for installation.

B. Work Specified Elsewhere

1. Installation of raceways, pull-boxes, floor boxes, and conduit (provided under electrical work).
2. Installation and termination of house network systems.
3. Cutting, patching, and painting walls, unless damaged, performing the work described within.

C. Coordinated Work

1. Coordinate with related trades to schedule the work and ensure a complete installation in accordance with the schedule outlined by the owner.

1.9 CONTRACTOR'S QUALIFICATIONS

A. General

1. The PSC shall be a company that regularly engages in the furnishing and installation of systems similar in complexity to those required for this project and in this section and must meet the following requirements in each discipline listed here to include Audio, Video/Control, Lighting, and Rigging.
2. A subcontractor employed as the "Presentation Systems Contractor" must be accepted and/or pre-approved by virtue of their standing and agreements with all equipment manufacturers to be installed and commissioned in this section. The PSC must be

acceptable to the Architect and the Consultant and shall be identified on the Bid Proposal Form.

3. The primary business of the PSC shall be the sale and installation of professional performance-related sound, video, control, lighting, and rigging systems.
4. The PSC shall have no less than five years of experience with equipment and systems of the specified types of systems that follow.
5. Proof of successful completion with present key staff of five projects of the type or magnitude specified here in this project.
6. Regular business under the same name and/or address for a period of five years.
7. Have technicians trained in the specific installation and maintenance of the equipment supplied.
8. Have suitable service facilities and test equipment for providing competent service for all types of professional dimming, rigging, sound, video, and control system equipment.
9. Maintain shop and office facilities within a 150-mile radius of the project site.
10. Employ a minimum of 1 full-time engineer with InfoComm International Certified Technology Specialist - Design (CTS-D) certification.
11. Employ a minimum of 1 full-time installer with InfoComm International Certified Technology Specialist - Installation (CTS-I) certification.
12. At the request of the Owner, the PSC shall demonstrate to the satisfaction of the Architect and Consultant that the PSC has:
 - a. Adequate facilities and equipment to complete the work.
 - b. Adequate staff with commensurate technical experience.
 - c. Suitable financial status to meet the obligations of the work.

B. Audio

1. Personnel engaged in the audio portion of this project shall have the following certifications:
 - a. Biamp, Q-Sys, & BSS Audio senior-level programming
 - b. Dante Level 3 Master Certification
 - c. InfoComm International Certified Technology Specialist - Design (CTS-D)
 - d. InfoComm International Certified Technology Specialist - Installation (CTS-I)
 - e. EASE Training
 - f. Syn-Aud-Con certification
2. Employ a qualified "sound system and A/V production expert" with sufficient experience in production to provide training and assistance to the Owner during the initial system use period.

C. Video / Control

1. Personnel engaged in the video portion of this project shall have the following certifications:
 - a. Crestron Master Programmer
 - b. Crestron Digital Media Engineer
 - c. Extron AV Associate certification
2. Employ a minimum of 1 full-time programmer who is a Crestron Certified Programmer.

D. Lighting

1. The PSC shall be pre-approved as an ETC lighting provider for all stage lighting fixtures, stage/house dimming and dimming controls with various interfaces.
2. Lighting system equipment in this section shall be provided, installed, and commissioned by a pre-approved ETC dealer.
3. If the system design requires, the PSC shall be responsible for the convergence of the house and theatrical lighting system with the AV remote control system. This will enable lighting presets to be recalled from the AV control system.

E. Rigging

1. The General Contractor shall provide and install structural steel to support the following;
 - a. All main and delay loudspeaker hanging locations. Typical load of 500-750 lbs.
 - b. All hoist and lighting batten locations. Loads vary
 - c. All dead hung batten locations. Loads vary
2. The PSC shall employ only fully trained permanent stage riggers and mechanics who can be assisted by common laborers for the erection and installation of the stage rigging equipment. The riggers shall be completely familiar with the types of equipment being installed.
3. A competent Job Supervisor shall be on the job site at all times while work is in progress. The Job Supervisor of rigging shall represent the PSC, and all directions given by him/her shall be as binding as if given by the PSC directly. The PSC shall have on-site an installer with the rigging manufacturer certification.

F. Subcontracting

1. Any other Contractor/Supplier who intends to bid this work as the prime Contractor/Supplier and does not meet the required qualifications shall employ the services of a single "Presentation Systems Contractor" who does meet the requirements noted above and is approved by the Owner, Architect and Consultant as well. This "Presentation Systems Contractor" shall:
 - a. Furnish the equipment.
 - b. Meet all qualifications stated earlier in this section.
 - c. Shop fabricates the equipment racks and subassemblies.
 - d. Make all audio, video, and control connections to equipment racks, each piece of equipment, and connection panels.
 - e. Continuously supervise the installation and connections of cable and equipment.
 - f. Program the digital signal processor, video processing, and control systems.

1.10 BID SUBMITTALS

A. Along with the bid price, the PSC shall include the following:

1. Proposed team member names, certifications, and biographies for each. Include names and biographies of service and technical support personnel who will be responsible for this project after completion.
2. Equipment list noting equipment quantities, manufacturer, brief description, and specification number.

3. Statement that the bid is based on specified products.
4. Address of staffed office within 150 miles of the job site.
5. Statement that the Contractor has an established toll-free hotline and will provide 24-hour/7-day-a-week phone support and on-site emergency service as necessary to correct technical failures.
6. List of five installations completed within the last three years, which are similar in size, type, and scope to the work specified in this Section. Include the project name, installation date, contact name, and phone number.
7. Examples of typical design drawings (elevations, mounting details, millwork details, etc.)
8. A minimum of five touch panel menu templates from projects completed by the PSC.
9. Examples of training materials (PowerPoint slides, quick-start guide).
10. Target project schedule with timeline, skills, and labor requirements.
11. Client reference letters.
12. Any proposed subcontractors, their qualifications, and scope of work.

1.11 PROJECT SUBMITTALS

- A. Upon award of the contract, PSC shall provide:
 1. Preliminary project schedule with timeline, skills, and labor requirements.
 2. Name and qualifications of PSC personnel who shall be supervising the installation of the system. This person shall be a full-time employee of the PSC. The PSC shall submit a minimum of three (3) suitable bound sets, or electronic documents, of the following for review by the Architect and the Consultant. Refer to the General and Special Conditions for additional set(s) which may be required. All documents shall be submitted prior to ordering any materials.
 3. A complete list of all equipment and materials which are to be furnished. Accompanying the list shall be manufacturers' specifications or cut sheets for all equipment.
 4. Shop drawings generated by the Contractor. The Contractor shall be provided with electronic copies of the floor plans, device layouts, and room sections only for use in preparing their shop drawings. The Contractor is responsible for editing these sheets as required by these submittal requirements. The Contractor is required to generate all other sheets as required by these submittal requirements.
 - a. Detailed wiring diagrams showing the interconnection of components and products, wiring and cabling diagrams depicting cable types and wire numbers, and device designators.
 - b. Plan view showing locations of all equipment. Plan(s) shall be properly dimensioned, and all equipment labeled.
 - c. Wall elevations and room sections showing all installed equipment. Elevations and sections shall be properly dimensioned, and all equipment labeled.
 - d. Equipment rack layout details, including power, grounding, ventilation, and conduit/cable entry as applicable.
 - e. Loudspeaker system suspension schematic, including hardware types and load capacity.

- f. Complete drawings of custom-fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material, color, and bill of material.
- g. Power requirements, one-line riser diagrams, and installation circuit diagrams for electrical equipment. Show all required wire sizes and counts between all components.
- h. The manufacturer's detailed shop drawings of all dimming, control, and distribution equipment and published literature on all equipment.

1.12 FINAL INSPECTION AND TESTING

- A. In addition to supplying and installing the equipment as part of this contract, the PSC is to aid the owner's consultant during on-site observations, systems commission/performance verification, video system proof, and owner training and production assistance.
- B. The process of testing the system may necessitate moving and adjusting certain components, such as loudspeakers and video projectors. Movement and replacement, as required, are to be performed at no additional expense to the Owner.
- C. In the event further adjustment or Work becomes evident during testing, the Contractor shall continue his work until the system is acceptable at no additional expense to the Owner. If approval is delayed because of defective equipment or failure of equipment or installation to meet the requirements of these specifications, the Contractor shall pay for additional time and expenses of the Consultant and Owner at the standard rate in effect at that time.

1.13 WARRANTY

- A. All equipment is to be new and warranted, free of faulty workmanship and damage.
- B. The total system (parts and labor) is to be warranted free of defects for a period of one year from the date of final acceptance.
- C. The entire system (excluding lamps and fuses) shall be fully factory tested prior to shipment and shall be guaranteed against defects in material and workmanship for one year from the date of acceptance by the Owner or (18) eighteen months from the date of shipment, whichever occurs first.
- D. No equipment with a shorter warranty shall be considered, and the equipment purchased shall be covered by this warranty. Unspecified length of warranties shall not be acceptable.
- E. Contractor shall provide for replacement of defective materials and repair of faulty workmanship within (48) forty-eight hours of notification by the owner, guaranteed at no cost to the owner during the warranty period.
- F. Contractor shall provide emergency service and support 24 hours a day and 7 days a week. This service is intended as an emergency response to failures that require immediate help from a qualified systems technician. The Contractor shall provide this service through an established toll-free line. This emergency service must include a return call from a qualified systems technician within 2 hours. This emergency service must also provide an on-site visit from a qualified systems technician within 12 hours of the initial phone call, should it be deemed

necessary by both parties to resolve the service issue. This emergency service and support shall be made available throughout the warranty period at no additional charge to the owner.

- G. Paint and exterior finishes, fuses, and lamps are excluded from the above warranties except when damage or failure results from defective materials or workmanship covered by warranty.
- H. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturer warranties.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. PSC is to provide at least fourteen hours (2 each six to eight-hour session) of training to person(s) selected by the Owner on the operation and basic maintenance of all systems and equipment. In addition to training, a representative of the Contractor knowledgeable of the system installation and operation is to be present for the first special events selected by the Owner where all or any part of the sound and video systems is used. The training and event attendance is to take place during the 30-day period after system completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. It is the intention of these specifications to provide a complete and properly operating system. The major items of equipment shall be furnished in the quantity indicated by the project drawings or in the quantity specified herein. In the event of a quantity discrepancy between the drawings and specifications for an item, the PSC shall provide the greater. PSC is responsible for providing all accessories and miscellaneous equipment required to form a complete and operational system, including, but not limited to, power supplies, cabling, mounts, attachment hardware, and software licenses.
- B. Provide only new products and include the manufacturer's original factory warranty, product documentation, and the latest version of any software required for configuration and/or operation.
- C. The Manufacturer / Models listed in Part 2 - Products section, are representative of the equipment's capabilities and specifications that was used to determine the overall design of the various systems. If a PSC bidder chooses to bid a different manufacturer/model than what is listed, it is their responsibility to ensure the equipment that is bid is equal to, or better than the equipment listed in these specifications.
- D. Where the specifications list several manufacturers for a particular major item of equipment, such as power amplifiers, the PSC shall supply all of that item of equipment from one manufacturer.

2.2 AUDITORIUM – AUDIO PRODUCTS

- A. AUDIO SPEAKERS – LINE ARRAY
 - 1. 880 Watts Peak, 600 Watts Continuous
 - 2. 120 degrees nominal (500 Hz-16 kHz) coverage
 - 3. Frequency range 63Hz-17khz (-10 dB)
 - 4. Provide all brackets, hardware, and rigging components to mount per drawings
 - 5. Acceptable manufacturer/model, or better than:
 - a. JBL Pro SRX906LA

- B. AUDIO SPEAKERS – MAIN SUBWOOFERS
 - 1. Power handling – 1500W program
 - 2. 1x18” Driver
 - 3. 20 mm threaded pole socket
 - 4. Freq range of 34Hz-220Hz (±3dB)
 - 5. Provide all brackets, hardware, and rigging components to mount per drawings
 - 6. Acceptable manufacturer/model, or better than:
 - a. JBL Pro VRX918SP

- C. AUDIO SPEAKERS – WALL MOUNTED
 - 1. 90° x 50° Coverage
 - 2. 262H-1 Differential Drive® Low-Frequency Driver
 - 3. 2408H-1 High-Frequency Compression Driver
 - 4. 41 Hz to 18 kHz Frequency Response
 - 5. Bi-Amp/Passive Switchable
 - 6. NL4 speakON and Barrier Strip Inputs
 - 7. Acceptable manufacturer/model, or better than:
 - a. JBL AM5212/95 (*Confirm finish prior to ordering*)

- D. AUDIO SPEAKERS – CEILING MOUNT BACKGROUND
 - 1. Power Ceiling speakers to be 6.5” coaxial and have plenum back-cans
 - 2. Freq range: 75 Hz-20kHz
 - 3. Sensitivity: 89 dB, 1W @ 1M
 - 4. Speakers to have nominal conical pattern coverage of 110°
 - 5. Acceptable manufacturer/model, or better than:
 - a. JBL Control 26 (*Confirm finish prior to ordering*)

- E. AUDIO SPEAKERS – PENDANT MOUNT SPEAKER
 - 1. Pendant speakers to be 5.25” coaxial in a 10” tall enclosure
 - 2. RBI Radiation Boundary Integrator Technology
 - 3. 75 Watts, 8 ohms and 60W multi-tap transformer
 - 4. Speakers to have nominal conical pattern coverage of 120°
 - 5. Acceptable manufacturer/model, or better than:
 - a. JBL Pro Control 67 P/T (*Confirm finish prior to ordering*)

- F. AUDIO SPEAKERS – STAGE WEDGE MONITORS
 - 1. Pendant Speakers to be passive 2-way type
 - 2. Power handling – 600W program
 - 3. 1-12” LF Speaker and 1-1” VC HF drivers

4. 90° H x 50° V with rotatable constant directivity horn
5. Acceptable manufacturer/model, or better than:
 - a. JBL PRX412M (*Confirm finish prior to ordering*)

G. AUDIO POWER AMPLIFIER – PROGRAM DISTRIBUTION

1. Eight-channel in a 1U chassis
2. Capable of providing up to 1,000 W of power
3. Audio transport and control via standard gigabit Ethernet protocols and hardware
4. Allows for asymmetric power distribution across amplifier channels
5. Low-Z, 70 V and 100 V direct drive available on all channels
6. Acceptable manufacturer/model, or better than:
 - a. QSC CX-Q4K8-NA

H. AUDIO MICROPHONES – WIRELESS HANDHELD TRANSMITTER

1. Microphones shall have the added capability of 64Mhz bandwidth of digital tuning.
2. The handheld transmitter shall have a SM58 mic cartridge
3. Frequency Range: 50 Hz to 15 kHz
4. 1/10/20mW RF Output Power
5. Mute Mode, Backlit LCD
6. Secure AES-256 Encryption
7. Operates for up to 11 hours on two AA batteries.
8. Acceptable manufacturer/model, or better than:
 - a. Shure ULXD2/SM58=G50

I. AUDIO MICROPHONES – WIRELESS ANTENNAS & AMPLIFIER

1. Up to 64 MHz tuning range
2. Four receivers in a rugged 1RU metal chassis with an internal power supply
3. Dante™ digital networked audio over Ethernet
4. Up to 60 dB of independently adjustable gain for each channel
5. 24-bit/48 kHz digital audio delivers clear and accurate sound reproduction
6. Acceptable manufacturer/model, or better than:
 - a. Shure ULXD4Q=G50 Receiver

J. AUDIO MICROPHONES – INSTRUMENT MICROPHONE

1. Frequency Range: 40 Hz to 15 kHz
2. Sensitivity: 56 dBV/Pa (1 kHz, Open Circuit Voltage)
3. XLR Output Connector
4. Acceptable manufacturer/model, or better than:
 - a. Shure SM57-LC

K. AUDIO MICROPHONES – ANTENNA DISTRIBUTION SYSTEM

1. Five-Way RF Signal Output
2. QLX-D, ULX, ULX-D, SLX & BLX4R Receivers
3. Front-Mounting Antenna Hardware
4. 4 DC power feeds for receivers (15V, 2.5A max)
5. Outputs for Antenna Bias (12 VDC, 300mA)
6. Acceptable manufacturer/model, or better than:

a. Shure UA845UMB

L. AUDIO INTERCOM – WALL SPEAKER STATION

1. Gooseneck microphone connector with VOX circuitry
2. Talk/Listen from a headset mic, telephone handset, or push-to-talk microphone
3. Four modes of operation that are internally programmable via dip switches
4. Balanced local program input with separate level control
5. Visual and audible call signaling
6. Optional 4-wire daughter board for flexibility
7. Wall or console mountable or optional V-Box for portable or desktop use
8. Built-in speaker
9. Acceptable manufacturer/model, or better than:
 - a. Clear-Com KB-702GM

M. AUDIO INTERCOM – ASSISTIVE LISTENING SYSTEM

1. (1) RF stationary transmitter
2. (1) Universal Antenna Kit
3. (1) Universal Rack Mounting Kit
4. (4) DSP RF Receivers
5. (4) Universal Ear Speaker
6. (2) Intelligent Earphone/Neck Loop Lanyard
7. (1) Intelligent 12-Unit charging tray
8. (1) Dual RCA to Dual RCA cable, 6.6 ft
9. (1) Assistive Listening Notification Signage Kit
10. Acceptable manufacturer/model, or better than:
 - a. Listen Technologies LS-55-072

N. AUDIO INTERCOM – INTELLIGENT DSP RECEIVER KIT

1. (12) Intelligent DSP RF Receiver Package 1 (72 MHz)
2. (12) Integrated neck loops/lanyards and universal ear speakers
3. (1) Intelligent 12-Unit Charging Tray
4. Advanced DSP SQ (TM) noise reduction technology
5. Acceptable manufacturer/model, or better than:
 - a. Listen Technologies LP-41-072-01

O. AUDIO DIGITAL – SIGNAL PROCESSOR (DSP)

1. DSP shall meet the following minimum criteria:
 - a. 128 x 128 network audio channels
 - b. 8 analog input x 8 output x 8 flex channels
 - c. Expandable to 32 x 32 with licensing
 - d. 1RU rack mount
 - e. Supports standard DSP functions such as auto-mixing, routing, parametric EQ, Hi-Lo band pass, muting, etc.
2. Acceptable manufacturer/model, or better than:
 - a. QSC Q-Sys Core 110f w/ scripting, UCI, and Dante licensing as required

P. AUDIO DIGITAL - MIXER STAGE BOXES

1. Compatibility: Rivage PM7 Mixing System, CL Digital Mixer, QL Digital Mixer
2. 16 XLR Inputs
3. 8 XLR Outputs
4. Connects via Cat5
5. Maximum Distance 328'/100m
6. The stage box shall be a 3RU rack mountable device
7. Acceptable manufacturer/model, or better than:
 - a. Yamaha Rio1608-D2

Q. AUDIO DIGITAL - MIXER

1. The mixer shall be capable of mixing 48 mono and 2 stereo channels
2. The mixer shall be able to be controlled from an iPad with the proper application loaded.
3. The mixer shall have (32) local mono inputs and (16) outputs
4. The mixer shall have (1) slot for optional modules
5. The mixer shall have as standard connections, I/O a Primary and Secondary DANTE, Ethernet, Word Clock, and AES/EBU output
6. Acceptable manufacturer/model, or better than:
 - a. Yamaha TF5

R. AUDIO – DIRECT BOX

1. Floating Transformer-Balanced XLR Output for Maximum Isolation
2. SPKR Mode Handles Amplifiers up to 600W RMS
3. HI CUT Filter Reduces High-Frequency Hiss
4. GND/LIFT Switch Eliminates Hum and Buzz
5. Flush-mounted Switches and Connectors Resist Damage
6. Passive Design Requires No Batteries or Phantom Power
7. Rugged ProCo Uni-Box Construction Provides Superior Protection and Shielding
8. Acceptable manufacturer/model, or better than:
 - a. ProCo Sound DB1

S. AUDIO – WALL CONTROLLER

1. Ethernet-based control solution for Q-SYS and other third-party AV products supporting UDP, TCP/IP control
2. Menu customization with unIFY Control Panel software
3. High-contrast OLED display provides easy-to-read menus and status
4. PoE powered - simple, single CAT-5e/CAT-6 cable installation
5. Acceptable manufacturer/model, or better than:
 - a. Attero Tech Axon C1

T. AUDIO – SPEAKER VOLUME CONTROL

1. 50-watt power rating
2. Attenuation: 3dB per step (33dB total)
3. Volume Positions: 0-10
4. Use With 25/70/100V speaker line
5. Acceptable manufacturer/model, or better than:
 - a. Lowell 50LVC-DW (*Confirm finish prior to ordering*)

U. AUDIO – AV FLOOR BOXES

1. Provide floor boxes as indicated on drawings
2. Acceptable manufacturer/model, or better than:
 - a. FSR FL-500

2.3 AUDITORIUM – VIDEO PRODUCTS

A. VIDEO PROJECTOR – MAIN PRESENTATION

1. Native resolution: WUXGA, 1920x1200
2. 3-chip DLP
3. Solid-state laser light source
4. Brightness: 20,00 Lumens
5. Provide the correct lens for throw distance. Verify model number
6. Acceptable manufacturer/model, or better than:
 - a. Epson EB-PU2020B (V11HA66820)

B. VIDEO PROJECTOR – MOTORIZED PROJECTION SCREEN

1. The screens shall meet the following specifications.
 - a. 260” W x 163” H x 307” diagonal viewing area
 - b. Screen shall be electric with an external LV interface included
 - c. Tab-tensioned front projection material with 60” black drop
2. Acceptable manufacturer/model, or better than:
 - a. Draper Paragon V Series

C. VIDEO PROJECTOR – WALL & SUSPENDED MOUNTS

1. The main projector mount shall be wall-mounted to the upstage wall.
2. The scenic projectors shall be suspended from the structure above the stage.
3. Supply necessary column pipes, structural adapters, and projector mounting adapter plates per drawing details
4. Acceptable manufacturer/ model, or better than:
 - a. Chief (Milestone)

D. VIDEO DISPLAY – FLAT PANEL TV

1. LED-backlit display w/ native resolution: 3,840 x 2,160 (UHD)
2. 85” diagonal viewing area
3. Brightness: 330 nits
4. Acceptable manufacturer/model, or better than:
 - a. LG 86UR640S

E. VIDEO DISPLAY – FLAT PANEL TV

1. LED-backlit display w/ native resolution: 3,840 x 2,160 (UHD)
2. 55” diagonal viewing area
3. Brightness: 400 nits
4. Acceptable manufacturer/model, or better than:
 - a. LG 55UR340C

F. VIDEO DISPLAY – DISPLAY MOUNTS

1. All mounts are to be UL-certified and rated for the appropriate size display to be mounted.
2. Acceptable manufacturer/model, or better than:
 - a. Chief

G. VIDEO DISPLAY – RACK MOUNT PREVIEW

1. The LCD displays shall be a dual 7” rack mount unit
2. Each individual display shall meet the following minimum specifications.
3. 1920x1200 native resolution
4. LED backlight
5. 450 cd/m² brightness
6. 1100:1 Contrast ratio
7. HDMI Input and output
8. Acceptable manufacturer/model, or better than:
 - a. Marshall Electronics M-Lynx-702

H. VIDEO CAMERA – PTZ HDMI

1. 30x Total Zoom
2. 1/2.5-type Exmor R CMOS sensor
3. 63° field of view
4. 70.2° horizontal field of view
5. Controller/interface w/ HDMI, USB2.0, and H.264 streaming outputs
6. Manual pan and tilt
7. Power to be with a 12VDC power supply or PoE+
8. Acceptable manufacturer/model, or better than:
9. Vaddio RoboSHOT 30E QUSB Camera System (999-99190-000) *Confirm finish prior to ordering*

I. VIDEO CAMERA – HDMI EXTENSION SYSTEM

1. Video, power, network, and control on a single Cat5e (or better) cable
2. Supports cable runs up to 328'
3. Works with RoboSHOT UHD HDBaseT cameras
4. Bidirectional control via Ethernet and RS-232
5. Transmits and receives HDMI video up to 1080p60
6. Power Input: 48 VDC, 1.4 Amp Power Connection
7. Acceptable manufacturer/model, or better than:
 - a. Vaddio OneLINK HDMI Extension System (999-1105-043)

J. VIDEO TRANSMITTER – RACK RECEIVER

1. Receives HDMI plus control and analog audio up to 330 feet (100 meters) over a shielded CATx cable
2. Supports computer and video resolutions up to 4K
3. Supported HDMI specification features include data rates up to 10.2 Gbps, Deep Color up to 12-bit, 3D, HD lossless audio formats, and CEC pass-through
4. Extron XTP DTP 24 shielded twisted pair cable is strongly recommended for optimal performance
5. Compatible with CATx shielded twisted pair cable

6. Acceptable manufacturer/model, or better than:
 - a. Extron DTP HDMI 4K 330 RX (60-1331-13)

K. VIDEO TRANSMITTER – WALL TRANSMITTER

1. 1-gang decora style transmitter
2. Transmits HDMI plus control and analog audio up to 230 feet (70 meters) over a shielded CATx cable
3. Supports computer and video resolutions up to 4K
4. Bidirectional RS-232 and IR pass-through for AV device c
5. Accepts additional analog stereo audio signals
6. Acceptable manufacturer/model, or better than:
 - a. Extron DTP T HWP 4K 231 D (60-1421-52) - *Confirm finish prior to ordering*

L. VIDEO – SWITCHER & CONTROL PROCESSOR

1. All-in-one 8x4 4K matrix switcher, scaler, audio DSP, audio power amplifier, and control processor
2. Two DTP inputs and six HDMI inputs
3. Two independently scaled DTP outputs with mirrored HDMI outputs
4. Integrated DTP inputs and outputs support transmission of video, control, and audio up to 330 feet (100 meters)
5. 2U, full rack width metal enclosure
6. Acceptable manufacturer/model, or better than:
 - a. Extron DTP CrossPoint 84 (60-1368-01)

M. VIDEO – MEDIA PLAYER

1. Single 4k, dual 4k or 1080p60 output
2. 265 Decoding: Smaller file sizes and lower bitrates than H. 264
3. Synchronized playback across multiple displays
4. Digital audio player, Digital photo viewer, Digital video player
5. Acceptable manufacturer/model, or better than:
 - a. BrightSign HD224

N. VIDEO – MEDIA PLAYER

1. Single 4k, dual 4k or 1080p60 output
2. 265 Decoding: Smaller file sizes and lower bitrates than H. 264
3. Synchronized playback across multiple displays
4. Digital audio player, Digital photo viewer, Digital video player
5. Acceptable manufacturer/model, or better than:
 - a. BrightSign XT1144

O. VIDEO – BLU-RAY PLAYER

1. Supports playback of various formats of Blu-ray, DVD, and CD discs
2. HDMI, balanced XLR, and coaxial digital audio output terminals equipped
3. IP and RS-232C Ports for External Remote Control
4. 7.1 Surround Sound System
5. Dual USB Memory Ports
6. Acceptable manufacturer/model, or better than:

- a. Tascam BD-MP1

2.4 AUDITORIUM – CONTROL SYSTEM PRODUCTS

A. CONTROL SYSTEM – STREAMING PROCESSOR

1. Process two high-resolution AV sources from up to five available input signals
2. Record and stream at resolutions from 512x288 to 1080p/30
3. Internal 80 GB SSD
4. HDMI, component, composite, and optional 3G-SDI input
5. Produce MP4 media or M4A audio files that are compatible with virtually any media player
6. Acceptable manufacturer/model, or better than:
 - a. Extron SMP 351 (60-1324-01)

B. CONTROL SYSTEM – WIRED TOUCH PANELS

1. Refer to drawings to verify the location
2. Displays type shall be a 7” TFT active-matrix color LCD, 5-point multi-touch
3. Provide the necessary mounting bracket for the rack mount panel
4. Provide the necessary gateway interface for all wireless touch panels if applicable
5. Provide a PoE connection for power for wired touch panels
6. Acceptable manufacturer/model, or better than:
 - a. QSC TSC-70-G3 (*Confirm finish prior to ordering*)

2.5 AUDITORIUM – LIGHTING PRODUCTS

A. PERFORMANCE LIGHTING – LED ELLIPSOIDAL FIXTURES

1. The performance lighting ellipsoidal fixtures shall use LED technology
2. Light source combination of red, green, blue, and lime green LEDs
3. The fixtures shall have 54,000 Hr. life expectancy
4. Supply assortment of 5°, 10°, 14°, 19°, 26°, 36°, 50°, 70° lens tubes as needed
5. Acceptable manufacturer/model, or better than:
 - a. ETC ColorSource SPOT V (7423A10011)

B. LIGHTING – WALL BUTTON PANELS

1. Four button station configurations
2. Stations fit a standard backbox, including gang-able backboxes
3. Belden 8471 or Cat5 wiring, up to 1,640 feet of topology-free station wiring
4. Uses purpose-built ETC communication protocol
5. Acceptable manufacturer/model, or better than:
 - a. ETC E1004 (*Confirm finish prior to ordering*)

C. LIGHTING – DIMMER RACK

1. 24-position relay panel with support for one-, two-, or three pole relays and support for 300W phase adaptive dimmers
2. Built-in EchoConnect power supply for up to 6 Echo stations/ sensors and 5 output products
3. 14 in. width and 4 in. depth allows the cabinet to be flush- or surface-mounted in standard stud-width construction

4. UL924 LISTED emergency control bypass contact input
5. Acceptable manufacturer/model, or better than:
 - a. ETC ERP-24R1-24B1 Relay Enclosure 120/208V

D. LIGHTING – DMX / RDM ETHERNET GATEWAY

1. Convert DMX512 to Ethernet protocol for distribution
2. Eight DMX512 ports, individually configurable
3. 10/100 Mbps Ethernet network port
4. Voltage Rating: 24-48VDC
5. DMX-over Ethernet sending and receiving protocols:
 - a. Pathway ssACN (Secure sACN)
 - b. E1.31 streaming ACN (sACN)
 - c. Art-Net
 - d. Pathport Protocol
 - e. ShowNet
6. Acceptable manufacturer/model, or better than:
 - a. Pathway PWPP RM P8

E. NETWORK SWITCH – LIGHTING

1. The switch shall have 16 ports minimum
2. The switch shall be an unmanaged switch
3. The switch shall be at least 1Gb speed
4. There shall be 28 ports of PoE
5. Acceptable manufacturer/model, or better than:
 - a. Cisco

2.6 AUDITORIUM – COMPANY SWITCH

A. COMPANY SWITCH A

1. Power input:120/208V – Three-phase, four-wire plus ground
2. 65,000 AIC 100% rated 200A breaker
3. 65,000A SCCR symmetrical rated system
4. Reverse neutral and ground cam-style connector configuration
5. Current transformers can optionally be installed in the field for connection to external third-party power meters
6. Output connections accommodate single-pole Cam-style connectors and up to 4/0 class K cables using 500kcmil screw terminal
7. LED power indicators light up for proof that power is on/available between each phase and neutral
8. Lockout/Tagout point for breaker accepts third-party locks on built-in brackets for support of NFPA 70E procedures
9. Acceptable manufacturer/model, or better than:
 - a. ETC PSP-200 PowerSafe Pro 200A

B. COMPANY SWITCH B

1. Power input:120/208V – Three-phase, four-wire plus ground

2. 65,000 AIC 100% rated 400A breaker
3. 65,000A SCCR symmetrical rated system
4. Reverse neutral and ground cam-style connector configuration
5. Current transformers can optionally be installed in the field for connection to external third-party power meters
6. Output connections accommodate single-pole Cam-style connectors and up to 4/0 class K cables using 500kcmil screw terminal
7. LED power indicators light up for proof that power is on/available between each phase and neutral
8. Lockout/Tagout point for breaker accepts third-party locks on built-in brackets for support of NFPA 70E procedures
9. Acceptable manufacturer/model, or better than:
 - a. ETC PSP-400 PowerSafe Pro 400A

2.7 AUDITORIUM – ACOUSTIC CURTAINS

A. ACOUSTIC CURTAINS

1. Refer to drawings to verify the location
2. Acoustical drapes and curtain motors are installed by the owner-furnished contractor.
3. Acceptable manufacturer/model, or better than:
 - a. Owner Furnished Equipment

2.8 EQUIPMENT RACKS

A. EQUIPMENT RACKS – TYPE A

1. This equipment rack spec shall be used along with the rack elevation details on the drawings.
2. The rack shall be a wall-mount pivoting communications rack.
3. The rack shall be the 46-rack unit and 28” deep, with a standard 19” width for equipment mounting.
4. The rack shall pivot 90 degrees on its floor base.
5. Each rack shall have a logo panel of the system designer and integrator’s name and contact info.
6. The racks shall be equipped and priced with the following rack panel options
 - a. 1RU LOGO panels
 - b. 1RU solid blank panels
 - c. 2RU solid blank panels
 - d. 3RU solid blank panel
 - e. 1RU brush grommet
 - f. Vertical power distribution strip
 - g. Horizontal lacing bars
 - h. Rack light(s)
 - i. Model UPS-1000R Middle Atlantic UPS
7. Acceptable manufacturer/model, or better than:
 - a. Middle Atlantic SR series

B. EQUIPMENT RACKS – TYPE B

1. This equipment rack spec shall be used along with the rack elevation data on the drawings.
2. The equipment racks shall be free-standing communications racks for the control booth
3. The rack shall be the 14-rack unit and 22” deep, with a standard 19” width for equipment mounting.
4. The rack shall hinge open for access to the equipment.
5. Each rack shall have a logo panel of the system designer and integrator’s name and contact info.
6. The rack shall be equipped and priced with the following rack panel options. See drawing details for placement of these accessories
 - a. 1RU LOGO panels
 - b. 1RU solid blank panels
 - c. 1RU brush grommet
 - d. Vertical power distribution strip
 - e. Horizontal lacing bars
 - f. Rack light(s)
7. Acceptable manufacturer/model, or better than:
 - a. Middle Atlantic BRK series

2.9 MISC LOOSE/SUPPORT EQUIPMENT & INFRASTRUCTURE

A. CABLE – ANALOG AUDIO

1. Mic, line, speaker, intercom
2. Acceptable manufacturer/model, or better than:
 - a. Belden
 - b. West Penn
 - c. Clark

B. CABLE – VIDEO BASEBAND & BROADBAND

1. HD-SDI, analog video, RF
2. Acceptable manufacturer/model, or better than:
 - a. Belden
 - b. West Penn
 - c. Clark

C. CABLE – CAT5E / CAT6

1. Network, twisted pair video transmission (HDBaseT, DM, TP)
2. Acceptable manufacturer/model, or better than:
 - a. Belden
 - b. West Penn

D. CONNECTORS – AUDIO

1. Audio - XLRs, ¼”, Speakon
2. Acceptable manufacturer/model, or better than:
 - a. Neutrik

E. CONNECTORS – VIDEO

1. Video - BNC, RF for coax
2. Acceptable manufacturer/model, or better than:
 - a. Liberty
 - b. Canare

F. UNINTERRUPTED POWER SUPPLY

1. Acceptable manufacturer/model, or better than:
 - a. Trip Lite Smart 1500RM2U or approved equal

2.10 BASIS OF DESIGN

- A. Contractor shall be responsible for including all devices necessary to ensure a fully operational and complete A/V/L system.
- B. Basis of Design equipment used to create signal flows and other documentation.

2.11 AUDITORIUM

A. AUDIO SYSTEM

Qty	Manufacturer	Model	Description
10	JBL	SRX906LA	Line Array Speakers
4	JBL	VRX918SP	Subwoofers
3	JBL	AM5212/95	Wall Mounted Speakers
6	JBL	Control 26CT	Recessed Ceiling Speakers
4	JBL	Control 65 P/T	Pendant Speakers
2	JBL	PRX412M	Stage Monitors
6	Shure	ULXD2/SM58=G50	Digital Wireless Systems (Handheld Transmitters)
3	Shure	ULXD4Q=-G50	Wireless Antennas & Amplifier
1	Shure	UA845UWB	Antenna Distribution System
6	Shure	SBC200	Dual Docking Recharging Station
1	Clear-Com	MS-702	Master Speaker Station
3	Clear-Com	KB-702GM	Remote Speaker Station
1	ListenTech	LS-55-072	Assisted Listening System
1	QSC	CORE 110F-V2-NA	Audio System DSP
1	QSC	CX-Q4K8-NA	Program Distribution
1	Yamaha	TF5	Audio Console
1	Yamaha	Rio1608-D2	Mixer Stage Box
3	Lowell	50LVC	Wall Volume Control, Finish TBD
3	FSR	FL-500	Floor Boxes
Lot	Custom	Custom	I/O Plates and panels for Mic, Line, Intercom, Speakers, Network Signal Patching, etc.

B. AUDIO DELIVERABLES

Qty	Manufacturer	Model	Description
1	ListenTech	LP-41-072-01	DSP Receiver Kit
3	Shure	SM57	Wired Instrument Mic
6	ProCo	AQ-15	15ft F/M XLR Mic Cable
6	ProCo	AQ-25	25ft F/M XLR Mic Cable
2	ProCo	EVLGCN-25	¼” Instrument Cable 25ft
4	ProCo	LSCNN-25	10AWG Cable 25ft
2	ProCo	DB1	Direct Box
6	On-Stage	MS701B	Microphone Stand w/ Boom
1	Gator	12U Cast	Gator Case
4	Middle Atlantic	D2	2RU Drawers
1	Middle Atlantic	D3	3RU Drawer
1	Middle Atlantic	Custom	Logo Blank

C. VIDEO SYSTEM

Qty	Manufacturer	Model	Description
1	Epson	EB-PU2020B	20,000 Lumens LCD Laser Projector
1	Epson	ELPLM10	Middle-Throw Zoom Len
1	Chief	Custom	Projector Mount
1	Draper	Custom	307" Diagonal Motorized Screen w/ Black Drop
5	LG	86UR640S	86" LED Display
3	LG	55UR340C	55" LED Display
8	Chief	XTM1U	Extra Large Wall Mount
1	Extron	DTP T HWP 4K 231 D (60-1421-52)	HDMI Over CAT5 Transmitter, Wall Mount
1	Extron	DTP HDMI 4K 330 RX (60-1331-13)	HDMI Over CAT5 Receiver
1	Extron	DTP CrossPoint 84 (60-1368-01)	Switcher & Control Processor
1	Vaddio	RoboSHOT 30E QUSB Camera System (999-99190-000)	PTZ Camera
1	Vaddio	OneLINK HDMI Extension System (999-1105-043)	Camera Extension System
1	Tascam	BD-MP1	Blu-Ray Player
1	Marshall	M-LYNX-702	Rack Mount Preview
1	Bright Sign	XT1144	Media Player
1	Bright Sign	HD224	Media Player
1	Blonder Tongue	DGS-8	8-Way Digital Splitter
1	Blonder Tongue	ACA-35-1000	Apartment Complex Amplifier
1	Blonder Tongue	HPC-12	12-Port Headend Passive Combiner
2	Contemporary Research	QMOD-HDMI 2 HDTV	IPTV Encoder
Lot	Custom	Custom	Plates & Panels as Required

D. CONTROL SYSTEM

Qty	Manufacturer	Model	Description
2	Cisco	CBS-350-24FP-4G-NA	Network Switch
1	Extron	SMP 351 (60-1324-01)	Streaming Processor
1	QSC	TSC-70-G3	Wired Touch Panel
Lot	PSC	Miscellaneous	Cables, Connectors, Hardware, & Accessories Re- quired for Complete Installation

E. LIGHTING SYSTEM

Qty	Manufacturer	Model	Description
2	Pathway Connectivity	PWPP RM P8	DMX/RDM Ethernet Gateway
40	ETC	ColorSource SPOT V (7423A1011)	Performance Lighting SPOT Fixtures
3	ETC	E1004-4	4 Button Inspire Station, Finish TBD
1	ETC	ERP-24R1-24B1 Relay Enclosure 120/208V (7123A1012)	Dimmer Rack

1	ETC	PSP-200 PowerSafe Pro 200A	200A Company Switch
1	ETC	PSP-400 PowerSafe Pro 400A	400A Company Switch
Lot	Miscellaneous	As Required	Cables, Connectors, Hardware, & Accessories Re- quired for Complete Installation

F. EQUIPMENT RACKS

Qty	Manufacturer	Model	Description
1	Middle Atlantic	Custom	46RU-Stage Rack, Wall Mount
1	Middle Atlantic	Custom	14RU-Floor Rack
2	Middle Atlantic	Custom	1RU Logo Panel
4	Middle Atlantic	Custom	Vertical High-Density 20A Power Distance
20	Middle Atlantic	Custom	Horizontal Lacing Bars
2	Middle Atlantic	Custom	Rack Work Lights
8	Middle Atlantic	Custom	1RU Blank Rack Filler Panels
4	Middle Atlantic	Custom	2RU Blank Rack Filler Panels
2	Middle Atlantic	Custom	3RU Blank Rack Filler Panels
1	Middle Atlantic	Various	Rack Blank Panels, Vent Panels, Cable Management, Power Distribution, UPS, & Accessories as Required

PART 3 - EXECUTION

3.1 ACCURACY OF DATA

- A. It shall be the sole responsibility of the Contractor to verify all dimensions, take his own field measurements, and install all work to suit conditions encountered on the job site.
- B. The drawings are generally diagrammatic and, except where dimensions are indicated, are not intended to show the exact locations of outlets, conduits, etc. All work shall be installed as nearly as possible in the locations indicated, with minor adjustments as required to avoid interferences with structure or the work of other trades.
- C. Prior to beginning work, the Contractor shall carefully examine all construction drawings and the job site and report to the Owner any discrepancies or interference that may be discovered. If, during the course of construction, any such discrepancies or interferences are noted, the Contractor shall promptly report them to the Owner. Failure to report such discrepancies or interferences shall result in the correction of the same at the Contractor's expense. All work under this specification, which either interferes with the architectural or any other work or deviates from the drawings and specifications without prior approval of the Owner, shall be altered by the Contractor at his expense. These alterations shall clear such interferences or shall comply with the drawings and specifications as directed by the Owner.

3.2 MECHANICAL

- A. Except for portable equipment, all other equipment must be permanently installed. This shall include equipment racks, speakers, cables, etc. Fastenings and supports must provide a safety factor of at least three times what is required for safe support. Precautions must be taken to prevent electrostatic and electromagnetic hum and radio frequency interference. All electronic equipment must be easily accessible and have adequate ventilation.

3.3 CONNECTIONS

- A. All low-voltage wiring connections must be made with rosin core solder or mechanical connectors as specified. Terminations on all cables must be dressed properly with shrink tubing. All low voltage control level connections to terminal blocks are to be made with crimp-on spade lugs. All crimp-on connectors must be fastened with the proper tool as specified by the manufacturer. Improper crimping will be a cause for rejection. All "drain" wires on microphone and line level terminations are to be properly dressed using transparent shrink tubing to avoid the possibility of shorting "whiskers."

3.4 LABELS

- A. All wiring is to be numbered on both ends with "EZ Code" type markers. Wire numbers are to be secured with transparent shrink-tubing. Wire numbers are to follow a logical sequence and are to be listed on the proper document. "Brady" type labels are acceptable.

3.5 INSTALLATION

A. General

- 1. Installation shall include the delivery to the installation site, unloading, setting in place, mounting, and securing equipment to walls, floors, ceilings, cabinetry, or other structures.

Also, interconnection of any cables, wires, fiber optics, or other infrastructure. Any equipment alignment, adjustments, menu settings, or other requirements to ensure the appropriate operation of the system.

2. All installation practices shall be in accordance with, but not limited to, these specifications, drawings, and intended system performance. Installation shall be in accordance with the AV industries best practices as outlined in Infocom CTS-I criteria. Local and National authorities have jurisdiction.
3. If in the opinion of the AV System Contractor, an installation, an installation practice is desired or required, which is contrary to these specifications and/or drawings, a written request for modification shall be made to the Consultant. Modifications shall not commence without written approval from the Consultant. Every effort will be made to respond to all written requests in a timely manner so as to not delay the installation or completion of the project.
4. During the installation and up to the date of final acceptance, the AV Systems Contractor shall be responsible and under obligation to protect finished and unfinished work against damage and loss. In the event of damage or loss, those items shall be replaced at no cost to the Owner.

3.6 SOUND SYSTEM TEST AND MEASUREMENT

- A. The contractor is to conduct a performance verification test for the Owner. The contractor must complete the installation and verify that it is in working order and conforms to the following performance criteria. These performance standards are set forth as an indication of a properly installed and functioning sound system. It is implied through his action of submitting a bid that the contractor has reviewed these documents and is in agreement with the concept and execution of the design of the specified sound system. No financial adjustments will be allowed for discrepancies discovered after the bid is accepted.
 1. In rooms where voice lift or voice reinforcement is required, there is a programmable DSP in the system. The contractor is expected to tune the system to eliminate any hot frequencies in the room that would cause premature feedback as well as blemish the sound quality of the microphones.
 2. Microphone line resistance: Less than 1.7 Ohms with short at the input jack. Measured from mixer end of microphone cable. Measure with an Ohm meter.
 3. Maximum amp output: 100% of rated power at less than 0.25% THD. Measure with a distortion analyzer.
 4. Signal-to-noise ratio: Better than 80 dB or an absolute noise level less than 62 dBm for systems with +18 dBm maximum line operating level. Measured at amplifier input with RMS voltmeter with dB scale.
 5. Audio frequency response: +/- 1 dB 50 Hz to 15 kHz control equalizer set flat and room equalizers switched out – Microphone input to amplifier output. Measure with RTA.
 6. Polarity: All microphones and source equipment are to be wired so as to be in absolute polarity with the loudspeaker systems. Measure with a polarity checker.
 7. Synchronize delay and fill systems to within 15 milliseconds of the first arrival of the primary loudspeaker system as measured on Smaart or TEF measurement systems.

8. Acoustic coverage: Maximum +/- 3 dB SPL variance front to rear / side-to-side in the audience area through the 4 kHz full octave band. Measure with octave band Sound Level Meter.
9. Acoustic amplitude response: With the room, equalizers switched in +/- 3 dB, the maximum deviation from the following curve averaged from three test positions in the audience area flat at 60 Hz to 2 kHz, 10 dB at 50 Hz, and 12 kHz. Measure with RTA.
10. Electroacoustic gain: No less than 15 dB from 500 Hz to 4 kHz with one microphone and 12-inch source to microphone distance. Gain is to be measured 50 feet from the source. Measure with a Sound Level Meter.
11. Maximum sound level: Greater than 85 dB-C for large conference spaces when the amplifier occasionally clips on program peaks. Measure with a Sound Level Meter.
12. Acoustic noise floor: No audible hum, hiss, or R.F. interference shall be audible under normal room conditions in the audience seating area and stage or platform areas.
13. All loudspeakers are to exhibit the same acoustic polarity. Measure with Polarity Checker (Galaxy Cricket).

3.7 VIDEO SYSTEM PROOF OF PERFORMANCE

- A. Verify all devices and cables match the information on the final drawings
- B. Test all inputs on the video switcher/scaler.
- C. Adjust Color Temperatures on projectors to accurately reproduce NTSC and RGBHV Data Color Bars.
- D. Adjust projector images to match the screen size, eliminating any over-scan, under-scan, or keystone.
- E. Adjust all switching functions to eliminate sync roll or glitches upon switching.
- F. Test all video sources for full operation. Test all data sources up to the maximum resolution of the display (projector, LED display, or video wall).
- G. Test audio output of switcher scaler. Verify that all input audio levels are equal. Verify maximum audio output does not exceed +4dB.
- H. Verify there's no 60hz grounding interference, aka "humbar," existing in displayed images. If so, thoroughly go through and verify that grounding procedures are implemented.
- I. Optimize projector contrast, sharpness, and brightness to avoid blooming and achieve optimal black level.

3.8 AV SYSTEMS CONTRACTOR CHECKOUT

- A. Before the Consultants Acceptance Tests are scheduled, the AV Systems Contractor shall perform his own system check-out. The Systems Contractor shall furnish all required test and measurement equipment needed to perform all work necessary to adjust, modify, and document the systems as it is specified to perform.
 1. Provide documentation that all digital and analog audio signal paths have been tested and verified.
 2. Provide documentation of sound system performance as outlined above.
 3. Provide documentation that all digital and analog video signal paths have been tested and verified. This includes all SDI, HDBaseT, DVI, HDMI, and other digital video transports.

4. Test all systems for compliance and performance using the following equipment or equipment that provides the same testing for more current state-of-the-art systems.
 - a. Audio testing:
 - 1) Signal generator
 - 2) AC millivolt meter
 - 3) Audio test set
 - 4) Source media (MP3, CD's, 1/8" stereo source)
 - 5) Any needed adapters
 - b. Video checks:
 - 1) Analog video generator (if applicable)
 - 2) Digital video signal generator
 - 3) Waveform / Vectorscope (if applicable)
 - 4) Prerecorded DVD or Blu-ray test disc
 - 5) Video cables and adapters
5. Ensure all gain settings, noise floor, gain before feedback, and signal-to-noise measurements are acceptable and in accordance with industry best practices.
 - a. Provide written documentation to support all audio adjustments and settings.
 - b. DSP
 - 1) In accordance to the specification and drawings, ensure that the DSP is programmed accordingly to deliver the intended operation. Verify all settings and programming for the proper operation of the following:
 - a) All communication and IP settings
 - b) Proper or current software version
 - c) Matrix routing / presets
 - d) Correct input and output names, gain settings, phantom power, and phasing
 - e) Correct NOM (number of open mics) and/or mix-minus settings
 - f) Automatic gain control (AGC) settings
 - g) Automatic mixer settings, if applicable
 - h) Limiters, filters, and compressor settings
 - i) Equalization – Room tuning
 - j) AEC settings
 - k) Delay setting (if applicable)
 - l) Audio teleconference settings such as Auto-Answer and disconnect, VoIP settings, and Control system phone number availability (speed dial list) for phone calls.
 - m) Programmer to document that all DSP functions are working properly in accordance with the specifications and drawings.
 - c. Video switchers:
 - 1) Ensure buttons are labeled as to the input source and output destination.
 - 2) Make sure all resolutions are correct.
 - 3) Verify HDCP keys are handled correctly
6. All-optical fiber runs are to be certified using industry-accepted test equipment. Fiber connections to have documentation supporting the following tests:
 - a. Measuring insertion loss

- b. Measurements from the OTDR
- 7. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications. Record all "normal" settings in the "System Operation Manual."

3.9 SYSTEM ACCEPTANCE TESTS

- A. System acceptance tests shall not be performed until the AV Systems Contractor Checkout has been completed and the test results have been reviewed. The System Acceptance Test will be supervised by the consultant and will consist of the following:
 - 1. A physical inventory of all equipment on-site will be taken and compared to the equipment list in the contract documents.
 - 2. The operation of all system equipment shall be demonstrated by the AV Systems Contractor.
 - 3. The AV Systems Contractor shall provide the necessary equipment for the Consultant to perform the AV tests.
 - 4. The AV System Contractor shall have on-site and available the latest as-built drawings, equipment inventory list, and manuals. One set of these documents is to have been sent to the Consultant prior to the Acceptance Test.
- B. Additional work by Consultant:
 - 1. In the event of defective equipment, or other adjustments that need to be made, the test may be postponed or continued later at the option of the Consultant.
 - 2. However, if there is a return trip necessary by the consultant and/or a member of the consultant's team as a result of improper installation or a failed system for performance standards, the consultant may charge the AV System Contractor directly or be deducted directly from payments (or the final payment) to the contractor. Hourly rates for the Consultant and various team members are as follows:
 - a. Consultant \$125
 - b. Project Engineer \$95
 - c. Programmer \$110
 - d. Network Engineer \$125
 - 3. Additional travel expenses such as a rental car or mileage will be billed as a cost plus a 10% markup and will be charged along with the labor.

3.10 THIRD-PARTY TESTING AND COMMISSIONING

- A. In addition to the standard system testing and commissioning as stated in this section, the owner has authorized an additional allowance for a 3rd party to perform, but not limited to, final system tests, sound system tuning, level calibrations, control settings, and commissioning.
- B. See Section 012100 for more information on this allowance.

3.11 DOCUMENTATION

- A. Upon final completion of the system, a documentation package/manual is to be turned over to the Owner and include the following items:

1. System signal flow diagrams (for audio, video, and control) showing all components, interconnections, connector types, and wire numbers. As-built revisions are to be noted on the submittal drawings.
2. Manufacturer instruction manuals for all electronics.
3. Product specification sheets for all equipment without instruction manuals, such as microphones, loudspeakers, and lighting instruments.
4. Copies of the proof of performance data. Provide one original (no photocopies) and one copy (photocopies are acceptable) of the total documentation package.
5. A single copy of the system signal flow diagram with wire numbers indicated is to be laminated and posted on the door of the sound equipment rack.
6. Special documentation is required as part of the Owner training and operation of the systems. This documentation is to consist of instruction sheets that describe the operation of the system from the stage. Each instruction sheet is to be a step-by-step “cookbook” with touchscreen panel screenshots with arrow indicators that describe the steps and functions. A laminated poster version of this instruction sheet is to be mounted on the side of each equipment rack. The bullet points detailed on this sheet include:
 - a. Turning on system power
 - b. Select the desired source
 - c. Adjust volume levels
 - d. Select lighting presets (where applicable)
 - e. Recording stop/start functions (where applicable)
 - f. VTC calling functions (where applicable)
 - g. Other functions of the Owner control panel

3.12 CLEAN UP

- A. During construction, periodically remove discarded containers and refuse from the job site. At the completion of the job, the sound system components and equipment areas are to be left clean and neat, and all refuse removed from the site.

3.13 TRAINING

- A. The AV System Contractor is to provide at least fourteen hours (2 each six to eight-hour sessions) of training to person(s) selected by the Owner on operation and basic maintenance of all systems and equipment. In addition to training, a representative of the AV System Contractor knowledgeable of the system installation and operation is to be present for the first special events selected by the Owner where all or any part of the sound and video systems is used. The training and event attendance is to take place during the 30-day period after system completion.

END OF SECTION 274116

SECTION 312000 – EARTH MOVING

1. SCOPE:

Under this heading shall be included the following:

- a) Excavation required for structures.
- b) Sub-cut excavation as required or designated.
- c) Excavation as required for roadways.
- d) Shoring, sheeting, and bracing as required.
- e) Wasting and disposal of excess or unsuitable materials.
- f) Furnishing and placing borrow material.
- g) Furnishing and placing granular foundation material.
- h) Compaction of all materials.
- i) Dewatering or unwatering as necessary to complete the excavations to the required depths and as necessary to maintain the excavation sufficiently dry so that all work can be accomplished.
- j) Site grading as required, including excavation, and backfill.
- k) Preparation of subgrades.
- l) All other work specified herein.

Excavation and backfill for outside utility systems and other underground piping is specified in Section 312002 of these Specifications.

2. GENERAL:

The Contractor shall accept the site in its existing condition and shall assume the risk of encountering whatever materials as may occur. Refer also to the paragraph on Differing Subsurface or Physical Conditions, in the General Conditions.

3. SOILS:

The soil borings furnished are indicative of the soils encountered at the location of the borings at the time the borings were taken. Groundwater conditions indicated on the boring logs are those prevailing on the date the borings were made. These levels vary seasonally.

4. DEWATERING AND PROTECTION AGAINST WATER:

The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and as required to maintain the excavations sufficiently dry so that all required work can be accomplished. The Contractor shall do such well construction, well pointing, sheeting, ditching, diking, and pumping and shall construct necessary drains, channels, sumps, and cofferdams to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the work and until the finished work is accepted by the Owner, except as otherwise specified.

The Contractor shall be responsible for the effect of dewatering operations on adjacent property and for the effect on water supplies located in the vicinity of the project.

Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility.

The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.

All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Route of dewatering pipe shall be subject to the Engineer's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.

Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to ensure that the dewatering system remains operational and effective throughout the period of time that it is required.

5. MATERIALS:

a) Earth Fill.

Earth fill, including pavement subgrades, shall consist of all suitable materials from required excavations. Suitable materials for earth fill shall generally be composed of sands, clay-sand mixtures and silt-sand mixtures classified as SW, SP, SP-SM, or SM by the Unified Soil Classification System. Clay-sand and silt-sand mixtures must be approved by the soil technician prior to being incorporated in fills. Clays, silts, and organic soils will be considered as unsuitable materials.

b) Excavated Materials.

All suitable materials from excavations shall be used in the permanent construction required under these Specifications. Suitable materials shall be excavated separately from materials to be wasted and the suitable materials shall be segregated by loads during the excavation operations and shall be placed in temporary stockpiles and later placed in the designated locations. Excavated materials, which, after drainage, are suitable for the embankment but which, when excavated are too wet for immediate compaction in the embankment, shall be placed temporarily in stockpiles until the moisture content is reduced sufficiently to permit them to be placed in the earth fills.

c) Excess Materials.

All excess materials from required excavations shall be removed from the site unless written authorization is given by the Engineer to stockpile the material on the site.

6. EXCAVATION:

Excavation shall include the loosening, loading, removing, transporting, stockpiling and disposing of all materials, wet or dry, necessary to be removed to construct all structures included in this Contract to the lines and grades, and at the locations, shown on the Contract Drawings. Excavation for outside piping, storm sewers and utilities systems is included in other Sections of these Specifications.

Excavation for structures shall conform to the depth and dimensions necessary for the proper installation of all structures detailed on the Contract Drawings. Unless shown on the Drawings excavation shall not be carried below the elevations shown on the Drawings. Where bottoms of excavations are slightly unstable and the Drawings do not require a stabilized granular backfill and the Engineer does not direct additional excavation and replacement, the Contractor may provide a gravel course, but such work will be considered as for the Contractor's convenience and will not be considered as extra work.

Where any unauthorized excavation is made below the elevation indicated on the Contract Drawings, the excavation shall be restored to the proper elevation with compacted, well graded granular backfill. Such backfill shall be compacted as specified in the Article entitled "Compaction".

Excavation for pipes under and adjacent to structures shall be made after the installation of the granular backfill. Excavations shall be made to the required depths, grades, alignment, and trench widths required for the installation of the pipe. Temporary sheeting and bracing shall be used as required to confine the trench size and width. Trench size and width shall conform to the requirements in Section 312002.

Excavation shall be made for roadways and other site work to the required depths, grades and alignment.

Excavations, where conditions require, shall be properly shored, sheeted and braced by the Contractor to maintain excavation in a condition to permit the safe and efficient installation of all items of Contract work. Upon completion of the various Contract items, all temporary forms, shores and bracing shall be removed. While being withdrawn, all voids left by the sheeting and bracing shall be carefully filled with sand and compacted.

7. TOPSOIL CONSERVATION:

Over areas requiring excavation and/or fill, there may be limited amounts of existing topsoil, suitable for future use. The Contractor shall strip all such topsoil and shall stockpile it for future use under this Contract. Except for topsoil material available from the excavation, topsoil shall be obtained from off-site borrow. See also the Article in Section 329200 entitled "Topsoiling" for requirements of topsoil to be used as such under this project.

8. UNSUITABLE MATERIAL:

Where material encountered is unsuitable for subgrade construction of roads, buildings and walks, such material shall be excavated to the required depth of compaction (generally two feet below pavement base course), disposed of off the site and property of the Owner and replaced with suitable material. Unsuitable materials are those classified as MH, CH, OH, OL, SC, and Peat in accordance with the Unified Soil Classification System. Excess water in material will not be a basis for establishing unsuitable material regardless of gradation. The Engineer shall be notified immediately upon encountering of unsuitable material.

9. BORROW:

It is anticipated that suitable material for required fill and backfill can be obtained from required excavation. Suitable materials shall be secured by the Contractor from off-site sources if required.

10. BACKFILLING:

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PERMIT SUBMITTAL
APRIL 2024

All excavation shall be backfilled to the lines and grades shown on the Contract Drawings. Backfill adjacent to structures shall not be placed until forms, form lumber and all debris from construction has been entirely removed from around the work. No backfilling shall be done in unsuitable weather or over ground that is frozen or too wet.

Backfill shall not be placed against structures until the concrete has cured at least 7 days. Backfill, in general, shall be placed in horizontal layers not more than 8 inches to 10 inches in thickness, except in the cases of embankment construction around structures and under roadway and piping locations, where backfill shall be placed in 6 inch layers, with each layer thoroughly compacted as specified hereinafter, prior to the addition of the succeeding layer.

Fill immediately adjacent to walls shall be hand tamped and special care shall be taken to prevent any wedging action or eccentric loading against the walls.

Fill material shall be free of organics, roots, or other deleterious materials, including frozen material, stones, or cobbles over 6 inches in maximum dimension. It shall be non-plastic granular material containing less than 15 percent fines passing the No. 200 sieve.

11. COMPACTION:

a) General.

Compaction of earth fill and all pavement subgrades shall be performed to the percentages of maximum standard or modified dry densities and to the depths as shown on the drawing or as follows:

1. Subgrades Under Paved Areas and Structures.
95 Percent Modified (ASTM Test D1557) 24 inches
2. Pedestrian Traffic Subgrades.
95 Percent Modified (ASTM D1557) 12 inches
3. Unpaved Areas To Be Grassed Or Sodded.
90 Percent Modified (ASTM D1557) Full Depth

b) Moisture Content.

All compaction shall be performed at material moisture contents within 3 percentage points, plus or minus of optimum. Compaction and proof rolling equipment shall be as outlined in Section 321216 or as may be required for the type of fill being compacted.

12. TESTING:

a) General.

The Owner will select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction. Payment for the testing will be by the Contractor as outlined in the Special Conditions. Copies of all test results shall be furnished to the Engineer.

Soil tests shall include one compaction test per 100 cubic yards, 100 linear feet of curb, 100 linear feet of subgrade along pavement centerline and 500 square yards of base and one "proctor" test for each type of fill material to determine if the proper compaction has been attained.

b) Moisture Density Tests.

Testing shall be in accordance with ASTM Method D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Engineer.

c) Field Density Tests.

Tests shall be made in accordance with ASTM Method D1556 and/or ASTM Method D 2922. If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests, required due to failure of the original test, shall be paid for by the Contractor and not be reimbursed by the Owner.

d) Submittals.

The soils technicians will submit formal reports of all compaction tests and retests to the Contractor, Owner and Engineer as soon as possible upon completion of the required tests.

This report information is to include but not be limited to the following:

1. Date of the test and date submitted.
2. Location of test.
3. Wet weight, moisture content and dry weight of field sample.
4. Description of soil.
5. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
6. Ratio of field dry density to maximum lab dry density expressed as a percentage.
7. Comments concerning the field density passing or failing the specified compaction.
8. Comments about recompaction if required.

e) Compaction Results.

The soils technician is to advise the Engineer and Contractor immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

13. GRADING:

Upon completion of other construction operations, the entire site, within the limits shown on the Drawings, shall be brought to the finished grades shown. All surfaces shall be sloped to the grades indicated and which will provide proper drainage. All surfaces shall be raked smooth and shall be free of all vegetable matter, debris and stones larger than 2-1/2 inches. Allow for thickness of required topsoil.

END SECTION 312000

SECTION 312001 – EROSION CONTROL

1. SCOPE:

Under this section shall be included all measures both temporary and permanent to control erosion and sedimentation, and protect all surface waters and property both on and off site. This shall include all labor, materials and equipment necessary to meet the requirements of this Section.

2. GENERAL:

It is the intent of this Specification that the Project and the Contractor comply with all applicable requirements of the Erosion and Sedimentation Act of 1975 and local City regulations and ordinances.

The Manual for Erosion and Sediment Control in Georgia further defines practices and requirements. The Contractor is responsible for maintaining all sediment and erosion control measures on the project site during construction. The Contractor is responsible for any damage caused due to failure to implement these requirements. A Soil Erosion and Sedimentation Control Permit has been obtained by the Owner so that periodic inspections may be made by the City. The Contractor is to cooperate with the person performing these inspections.

3. PLANS:

A Soil Erosion and Sedimentation Control Plan is included in the Contract Documents and is to be implemented as a part of the procedures necessary to implement requirements of the Act and applicable local regulations.

4. IMPLEMENTATION:

Implementation of the requirements of the Act is based on the following principles:

- a) The disturbed area and the duration of exposure to erosion elements should be minimized.
- b) Stabilize disturbed areas immediately.
- c) Retain or accumulate runoff.
- d) Retain sediment.
- e) Do not encroach upon watercourses.

5. SYMBOLS:

The Soil Erosion and Sedimentation Control Plan contains standard symbols for the different types of measures for implementing the Act. These symbols are defined for conditions, design criteria and construction specifications in Sections II and III of the Manual.

6. SPECIFIC REQUIREMENTS:

a) All disturbed areas shall be grassed by sodding or seeding, fertilizing, mulching and watering to obtain a ground cover which prevents soil erosion.

b) A temporary construction egress pad shall be installed and maintained at any point where construction vehicles enter a paved road, street or parking area. The pad shall be used to prevent mud from leaving the construction area. The pad shall be constructed as shown in the Manual for Erosion and Sediment Control.

c) All measures installed for sediment control shall be checked at the beginning and end of each day when construction is occurring to ascertain that the measures are in place and functioning properly.

d) Erosion control measures shall be inspected by the Contractor after each rainfall event and at least daily during prolonged periods of continuous rainfall. Contractor shall make repairs and adjustments as necessary to maintain the effectiveness of all sediment and erosion control measures.

END OF SECTION 312001

SECTION 312002 – EXCAVATION, TRENCHING AND BACKFILL FOR UTILITY SYSTEMS

1. SCOPE:

Under this heading shall be included the excavation, trenching and backfilling required for all underground utility systems.

Utility systems include sanitary sewers, storm sewers, water piping and force mains.

2. GENERAL:

Underground piping and utility systems which are to be installed in trenches whose lowest point of excavation is below the existing ground level, and which are unaffected by an excavation for structures, may be installed at any time during the course of the work. Piping and systems to be installed in or over fill, backfill or new embankments shall not be installed until all earthwork has been completed to rough grade, nor until settlement of the fill or embankment has taken place.

Braced and sheeted trenches and open trenches shall comply with all state laws and regulations, and local ordinances relating to safety, life, health and property. Also, this shall conform to the Occupational Safety and Health Standards for Excavations, Final Rule (29 CFR Part 1926) as printed in the October 31, 1989 issue of the Federal Register.

The sides and bottoms of the trenches shall be protected against any instability which may interfere with the proper laying of the pipe and as necessary for the safety of the workmen and others and as may be necessary to protect adjacent structures. Refer to safety requirements of the General Conditions and Special Conditions. Protective systems for trenches shall be utilized by the Contractor and shall conform with Section 1926.652, 29 CFR Part 1926, Final Rule.

3. LOCATION AND PROTECTION OF UTILITIES AND STRUCTURES:

It shall be the responsibility of the Contractor to acquaint himself with the location of all utilities and structures both present and proposed, also all existing surface structures which may be affected by work under the Contract. The location of any underground structures furnished, shown on the Plans or given on the site are based upon the available records but are not guaranteed to be complete or correct, and are given only to assist the Contractor in making a determination of the existence of underground structures.

Overhead utilities, poles, etc., shall be protected against damage by the Contractor, and if damaged by the Contractor, shall be replaced by him. The Contractor shall notify those who maintain utilities sufficiently in advance of the proposed construction so that they may locate, uncover and disclose such work. If the progress of construction necessitates the removal or relocation of poles, overhead utilities and obstructions, the Contractor shall make all arrangements and assume all costs of the work involved.

The Contractor shall provide for the continuance of the flow of any sewers, drains, water pipes, and water courses, and the like. Where such facilities, water courses, or electric overhead wires or conduits are interfered with by the work of the Contractor, the interruption shall be a minimum and shall be scheduled in advance with the Engineer and the utility owner.

The Contractor shall restore all facilities interfered with to their original condition or acceptable equivalent. The cost of such restoration or damage caused directly by his work shall be paid for by the

Contractor and shall be included in the prices bid for the items to which it pertains.

4. EXCAVATION AND TRENCHING:

- a) Excavation.
Excavate all materials encountered. See Article 9 for payment for removal of unsuitable materials.
- b) Caution in Excavation.
The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures in the trench zone may be determined before being damaged. He shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged because of his operations.
- c) Subsurface Explorations.
The Contractor shall make explorations and excavations at no additional charge to the Owner to determine the location of existing underground structures.
- d) Depth of Trench.
Utilities and other piping shall be laid in open trenches as shown and specified. Trenches shall be excavated to the designated lines and grades, beginning at the outlet end and progressing toward the upper end in each case. Trenches for pipe shall be shaped to the lower 1/3 of the pipe and provide uniform and continuous bearing. Bell holes shall be dug to allow ample room for working fully around each joint.
- e) Width of Trench.
Trenches shall be of minimum width to provide ample working space for making joints and tamping backfill. Width on each side of barrel of pipe shall be as shown on the Plans. Sides of trenches shall be closely vertical to top of pipe and shall be sheet piled and braced where soil is of unstable nature. Above the top of the pipe, trenches may be sloped. The width of the trench above this level may be wider for sheeting and bracing and the performance of the work.
- f) Alignment and Grade.
Trenches shall be excavated on the alignments shown on the Plans, and to the depth and grade necessary to accommodate the pipes at the elevations shown. Where elevations of the invert or centerline of a pipe are shown at the ends of a pipe, the pipe shall be installed at a continuous grade between the two elevations.
- g) Over Excavation.
Excavation in excess of the depth required for proper shaping shall be corrected by bringing to grade the invert of the trench with compacted coarse, granular material at no additional expense to the Owner. Bell holes shall be excavated to relieve bells of all load, but shall be small enough to ensure that support is provided throughout the length of the pipe barrel.

Excavation in excess of the depths required for manholes and other structures shall be corrected by placing a subfoundation of 1500 psi concrete, at no additional expense to the Owner.

If trenches are excavated to widths in excess of those specified, or if the trench walls collapse, the pipe shall be laid in accordance with the next better class of bedding at the expense of the Contractor.

5. TRENCHES:

Trenches shall be maintained in a safe condition to prevent hazardous conditions to persons working in or around the trench.

Braced and sheeted trenches and open trenches shall comply with all State and Federal Laws and Regulations, and local ordinances relating to safety, life, health and property.

The top portion of the trench may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, utilities, etc. The bottom of the trenches shall be graded to provide uniform bearing and support each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections excavated for bell holes and for the sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and in order that the pipe rests upon the trench bottom for its full length and shall be only of such length, depth and width for making the particular type of joints. The bottom of the trench shall be rounded so that at least the bottom one-third of the pipe shall rest on undisturbed earth for the full length of the barrel as jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by workmen skilled in this type of work.

The sides of all trenches and excavation for structures shall be held by stay bracing, or by skeleton or solid sheeting and bracing according to conditions encountered, to protect the excavation, adjoining property and for the safety of personnel. Bracing and shoring may be removed when the level of the backfilling has reached the elevation to protect the pipe work and adjacent property. When sheeting or shoring above this level cannot be safely removed, it may be left in place. Timber left in place shall be cut off at least 2 feet below the surface. No sheeting below the level of the top of the pipe may be removed.

6. DEWATERING AND PROTECTION AGAINST WATER:

The Contractor shall remove water from the site and shall lower the ground water level as necessary to complete the excavations to the required depths and so that all required work can be accomplished in the dry. The Contractor shall do such well construction, well pointing, sheeting, ditching, and pumping, and shall construct necessary drains, channels and sumps to keep his excavations and new structures clear of ground water, storm water or sewage and to keep his construction areas dry during the progress of the Work.

Adequate measures and protection shall be provided by the Contractor to protect his work from damage from uplift due to ground water, storm water, or flood water. Any damages which may result shall be the Contractor's responsibility.

The Contractor shall accept all responsibility for damage to the work of this Contract because of floods and water pressures and other water damages and shall accept all risks of floods and other events which may occur.

All water discharged by pumping operations shall be discharged so as not to interfere with work under this Contract or with existing structures and operations. Water from dewatering operations shall be conveyed to the existing drainage features, using piping and pumping facilities provided by the Contractor.

Route of dewatering pipe shall be subject to the Engineer's review. Discharge facilities and water quality shall comply with applicable regulations of State and Federal agencies.

Dewatering operations shall be uninterrupted and continuous during the course of the work so as not to endanger any construction in place or to present a hazard to workmen in and around the site. The Contractor shall take all measures necessary including, but not limited to, standby equipment and constant attendance to ensure that the dewatering system remains operational and effective throughout the period of time that it is required.

No water shall be allowed to run over any uncompleted portions of the work. No units of the work shall be constructed under water. The cost of dewatering shall be included in the price bid for the item of work for which it is required.

7. PILING EXCAVATED MATERIALS:

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways.

8. LIMIT TO LENGTH OF OPEN TRENCH:

The routine of operation shall be so organized to keep the length of open trench to a practicable minimum.

9. REMOVAL OF UNSUITABLE BEDDING MATERIAL:

Where, in the opinion of the Engineer, the subgrade of the pipe trench is unsuitable material, the Contractor shall remove the unsuitable material 6" deep and furnish and place stone backfill in the trench to stabilize the subgrade. Attention is invited to the fact that the presence of water does not necessarily mean that stone backfill is required. If well points or other types of dewatering will remove the water, the Contractor shall be required to completely dewater the trench in lieu of stone backfill. Stone backfill will be limited to areas where well pointing and other conventional methods of dewatering will not produce a dry bottom. Stone shall be placed 6" deep and 18" wider than the pipe at the barrel. The pipe shall be carefully bedded in the stone as specified or in accordance with the manufacturer's recommendations. Should overdepth excavation be necessary to remove unsuitable material below the specified bedding and to replace it with satisfactory material, the Contractor will be paid for this work, based on the following requirements:

a) Unsuitable materials for bedding are those classified as MH, CH, OL, OH and PT in accordance with the Unified Soil Classification System. Excavated soils that are too wet to compact shall not be classified unsuitable due to high moisture content alone.

b) When the trench is excavated to the plan depth or as required by these Specifications, and soft or other material not suitable for bedding purposes is encountered in the trench, the Contractor shall immediately notify the Engineer for inspection and measurement of the unsuitable material to be removed.

c) No overdepth excavation or backfilling of the overdepth excavated trench shall start until proper measurements of the trench have been taken by the Engineer for the determination of the quantity in cubic yards of unsuitable material excavated. Backfill material and backfilling shall conform to the requirements specified in Article 12 below.

d) No payment will be made for any overdepth excavation of soft unstable material due to the failure of the Contractor to provide adequate means to keep the trench dry.

e) No payment will be made for any overdepth excavation of the unsuitable material and

replacement not inspected and measured by the Engineer prior to excavation.

10. BEDDING OF CLAY, CONCRETE, DUCTILE IRON OR STEEL PIPE:

Pipe shall be laid on foundations prepared in accordance with ASTM C12 as modified herein and in accordance with the various classes of bedding required by the trench width and trench depth for the size of pipe to be laid. Bedding shall be included in the appropriate unit price bid for clay, concrete, ductile iron or steel pipe.

a) Class "A" Bedding.

Class "A" Bedding shall be achieved by either of the following two construction methods:

1. Concrete Cradle.

The pipe shall be bedded in a monolithic cradle of plain or reinforced concrete having a minimum thickness under the pipe barrel of one-fourth the inside diameter of the pipe but in no case less than 4 inches and extending up the sides to a height of at least one-fourth of the pipe outside diameter. The cradle shall have a width equal to the full width of the trench as excavated. The pipe shall be laid to line and grade on concrete blocking after which the concrete shall be placed to the limits described. Concrete shall be 3,000 psi concrete.

2. Concrete Arch.

The pipe shall be bedded in crushed stone or rounded gravel bedding material having a minimum thickness under the pipe barrel of one-fourth the outside diameter of the pipe but in no case less than 4 inches and shall extend up the sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain or reinforced concrete arch having a thickness of one-fourth the inside diameter of the pipe but in no case less than 4 inches at the crown of the pipe. The arch shall have a width equal to the full width of the trench as excavated.

b) Class "B" Bedding.

Class "B" Bedding shall be achieved by either of two construction methods:

1. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 inches greater than the radius of the outside of pipe with a width sufficient to allow 6/10 of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 inches above the top of the pipe.

2. The pipe may be bedded in compacted crushed stone, placed on a flat trench bottom. The crushed stone bedding shall have a minimum thickness of 1/4 the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 inches over the top of the pipe shall be billed with carefully compacted material.

c) Class "C" Bedding.

Class "C" Bedding shall be achieved by either of two construction methods:

1. The pipe shall be bedded in an earth foundation formed in the trench bottom by a shaped excavation which will fit the pipe barrel with reasonable closeness for a width of at least 50 percent of the outside pipe diameter. The side fills and area over the pipe to a minimum of 12 inches above the top of the pipe and shall be filled with compacted fill.

2. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of 4 inches under the barrel and shall extend 1/6 of the outside diameter up the pipe barrel at the sides. The remainder of the side fills and to a minimum depth of 12 inches over the top of the pipe shall be filled with compacted backfill. Class "C" Bedding shall be used except where the use of Class "A" or Class "B" bedding is shown on the Plans.

d) Class "D" Bedding.

Class "D" Bedding is achieved by shaping bell holes only on a flat trench and no care is taken to secure compaction at the sides and immediately over the pipe. This type bedding is not permitted.

e) Bell Holes.

Bell holes shall be provided in all classes of bedding to relieve pipe bells of all load, but small enough to ensure that support is provided throughout the length of the pipe barrel.

f) Stone Bedding.

Stone Bedding material shall consist of crushed stone or pea gravel, clean and graded, 95 to 100 percent of which shall pass a 3/4-inch sieve with 95 to 100 percent retained on a No. 4 sieve. Bedding material shall be placed on a flat bottom trench and thoroughly compacted by tamping or slicing with a flat blade shovel. Compacted bedding material shall be extended up the sides of the pipe to the heights shown for the various classes of bedding.

g) Overwidth Excavation.

If trenches are excavated to widths in excess of those specified below, or if trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding at the expense of the Contractor.

h) Borrow Backfill.

Borrow backfill will be required if there is not sufficient suitable material available from other parts of the work to backfill the trenches. Borrow backfill from approved borrow pits shall be used. Only those soils in the borrow pits that meet the specified requirements for suitable material shall be used.

i) Trench Widths.

Trench widths at the top of the pipe and depths for clay, concrete and metal pipes using the various bedding classes, shall not exceed those shown on the Plans.

11. BEDDING OF PVC PIPE, FRP PIPE AND HDPE PIPE:

a) Pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM D2321 as modified herein. Blocking shall not be used to bring the pipe to grade. Bedding material shall be included in the unit price for PVC, HDPE and FRP pipes.

b) Embedment materials listed here include a number of processed materials plus the soil types defined by the USCS Soil Classification Systems in ASTM D2487. These materials are grouped into categories according to their suitability for this application:

1. Class I.

Angular 6 to 40 mm (1/4 to 1-1/2 inches), graded stone including a number of fill

materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

2. Class II.

Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.

3. Class III.

Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

4. Class IV.

Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not to be used for bedding, haunching or initial backfill.

5. Class V.

This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inches) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching or initial backfill.

c) Compaction of foundation, bedding, haunching and initial backfill shall extend to the trench wall.

d) Embedment material in the area around the pipe shall be installed with care. Care shall be used to ensure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in three stages: First, to the center line of the pipe; second, to the top of the pipe; and third, to a point 12 inches above the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 90 percent Standard Proctor Density. Where unstable trench walls exist because of migratory materials such as waterbearing silts or fine sands, care shall be taken to prevent the loss of side support through the migratory action.

e) Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.

f) Trench depths, using the various bedding classes, shall not exceed those shown below:

MAXIMUM TRENCH DEPTH

<u>Pipe Size</u>	<u>Class IV Bedding Not To</u>	<u>Class I or</u>	
		<u>Class III Bedding</u>	<u>Class II Bedding</u>
All Sizes Be Used	16'	30'	

Density (Standard Proctor) of 90 percent minimum in pipe zone.

g) ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe" shall be used in conjunction with the above.

12. BACKFILLING:

Backfilling consists of placing suitable materials removed during the excavation into the excavated areas, placing embedment materials and compacting the same to a density equal to or greater than what exists before excavation or as specified herein.

Under backfilling operations is also included removal of excess materials and debris from the site, leveling all depressions caused by operation of equipment and maintaining the backfilled areas until accepted by the Owner.

All backfill material shall be free of stones, concrete and clay lumps larger than 1/3 cubic foot. Roots, stumps and rubbish which will decompose will not be permitted in the backfill. Backfill material shall have its moisture content corrected, as may be necessary before being placed in the trench to bring the moisture content to approximately "optimum" for good compaction. Any rock, stone, concrete, clay lumps larger than 1/3 cubic foot in volume, rubbish and debris shall be removed from the site and disposed of by the Contractor in a lawful manner.

Backfilling operations in this work are referred to herein as Backfilling at the Pipe Zone, Type "A" and Type "B".

Backfilling in the excavated areas below parts of proposed structures shall be referred to hereinafter as Type "A" Backfilling.

Where trenches cross or extend under structures or into present roadways, future roadways or parking areas as shown on the Plans, the backfilling shall be referred to hereinafter as Type "A" Backfilling.

Backfilling in all other areas shall be referred to hereinafter as Type "B" Backfilling.

a) Backfilling at the Pipe Zone.

Throughout the entire construction, backfilling at the pipe zone shall include bedding and shall be as follows: Backfill material shall be placed below, around each side, and over the top of the pipe, in approximately horizontal layers to a height of 12 inches over the top of the pipe. Layers shall be of such thickness to facilitate the required compaction. This backfill shall be well compacted by using mechanical tamping equipment in such manner as not to damage the pipe, pipe joints or shift the pipe alignment. Workmen shall not be permitted to walk over the pipe until at least 12 inches of compacted fill has been placed over the pipe. The Contractor shall not use water to obtain compaction except for adding water to the backfill material before placing in the trench to bring the moisture content to approximately "optimum" for good compaction.

b) Type "A" Backfilling.

Type "A" backfilling consists of placing sand and gravel or other suitable materials excavated from the trench in the trench in 6-inch-thick layers from a point 12 inches above the top of the pipe and mechanically tamped or compacted by rolling until the backfill density after compaction is equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Modified Proctor Test

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(ASTM D1557). No water shall be used to secure compaction except for adding water to the backfill material before placing in the trench to bring moisture content to approximately "optimum" for good compaction. Each 6-inch-thick layer shall be mechanically tamped before additional backfill material is placed in the excavated area.

c) Type "B" Backfilling.

Type "B" Backfilling consists of placing sand and gravel or other suitable material excavated from the trench in the trench in 12-inch-thick compacted layers from a point 12 inches above the top of the pipe. Each 12-inch-thick layer shall be compacted before additional backfill material is placed in the excavation. Only mechanical tamping, use of roller or small tractor will be allowed. The density of the backfilled material after compaction shall be not less than 90 percent of the maximum density obtainable at optimum moisture content as determined by the Modified Proctor Test (ASTM D1557). Except in the upper 12 inches, water shall be added to backfill material only before being placed in the trench in order to bring the moisture content to approximately "optimum" for good compaction.

13. PROTECTION OF WATER SUPPLY PIPES:

a) Horizontal Separation.

Sewers and force mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, such deviation may allow installation of the sewer or force main closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on the side of the sewer or force main and at an elevation so the bottom of the water main is at least 18 inches above the top of the sewer or force main.

b) Crossings.

Sewers and force mains crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. This shall be the case where the water main is either above or below the sewer or force main. The crossing shall be arranged so that the sewer or force main joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer or force main, adequate structural support shall be provided for the sewer or force main to prevent damage to the water main.

c) Special Conditions.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer or force main shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling.

14. UTILITY CONSTRUCTION IN OTHER EXCAVATION:

Where utilities are required to be constructed in areas also requiring excavation and backfill for other work, coordinate the work so that the parts come together properly and the construction of the various parts can be done without damage to other parts. Place bedding which will form bearing for pipes, using suitable material and shaping to the lower 1/3 of the pipe to provide uniform and continuous bearing. Compaction of backfill material which will form bearing shall be equal to that specified hereinbefore under Type "A" Backfilling. After the pipe or other utility is placed, backfilling shall proceed as specified herein before following the requirements specified under "Backfilling at the Pipe Zone," "Type 'A' Backfilling", and "Type 'B' Backfilling" as applicable.

15. TESTING:

a) General.

The Owner shall select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction. All testing will be paid for by the Contractor as provided in the Special Conditions. Copies of all test results shall be furnished to the Engineer.

b) Moisture-Density Tests.

Testing shall be in accordance with ASTM Method D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Engineer.

c) Field Density Tests.

Tests shall be made in accordance with ASTM Method D1556. Tests shall be made in accordance with the following minimum schedule or as required by the soils technician or as may be directed by the Engineer:

One test for each lift of backfill for each 200 feet of trench or fraction thereof.

d) Submittals.

The soils technicians will submit formal reports of all compaction tests and retests. The reports are to be furnished to the Owner and the Engineer as soon as possible upon completion of the required tests.

This report information is to include but not be limited to the following:

1. Date of the test and date submitted.
2. Location of test.
3. Wet weight, moisture content and dry weight of field sample.
4. Description of soil.
5. Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.
6. Ratio of field dry density to maximum lab dry density expressed as a percentage.
7. Comments concerning the field density passing or failing the specified compaction.
8. Comments about recompaction if required.

e) Compaction Results.

If any compaction test reveals that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests, required due to failure of the original test, shall be paid for by the Contractor without reimbursement by the Owner.

The soils technician is to advise the Engineer and the Contractor's Superintendent immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

16. CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS:

a) Excavation, Trenching and Backfilling Operations.

Excavation, trenching and backfilling along highways, streets and roadways shall be in accordance with the applicable regulations of the State Highway Department, and City Engineer with reference to construction operations, safety, traffic control, road maintenance and repair.

b) Protection of Traffic.

Provide suitable signs, barricades and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All signs removed by reason of construction shall be replaced as soon as condition which necessitated such removal has been cleared. No highway, street or roadway shall be closed without first obtaining permission from the proper authorities.

c) Construction Operations.

The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic:

1. Stripping.

Where the pipe line is laid along road shoulders, sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.

2. Trenching, Laying and Backfilling.

Excavate trenches, install pipe line and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated and excess material removed immediately.

3. Shaping.

Immediately after completing backfilling operation, reshape any damage to cut and fill slopes, side ditch lines, and shall replace top soil, sod and any other materials removed from shoulders.

d) Excavated Material.

Excavated material shall not be placed along highways, streets, and roadways in such manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.

e) Drainage Structures.

All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

f) Maintaining Highways, Streets, Roadways and Driveways.

The Contractor shall furnish a road grader which shall be available for use at all times for maintaining highways, streets and roadways. All such streets, highways and roadways shall be maintained in suitable condition until completion and final acceptance of the work.

Repair all driveways that are cut or damaged. Maintain them in suitable condition until completion and final acceptance of the work.

17. REMOVING AND RESETTING FENCES:

Where existing fences must be removed to permit construction, the Contractor shall remove such

fences. As construction progresses, reset the fences in their original location and to their original condition. All costs of removing and resetting fences and such temporary works as may be required shall be included in the prices for the utility line.

18. PROTECTING TREES, SHRUBBERY AND LAWNS:

Trees and shrubbery along trench lines shall not be disturbed unless absolutely necessary. Trees and shrubbery necessary to be removed shall be properly heeled-in and replanted. Heeling-in and replanting shall be done under the direction of an experienced nurseryman. Where utility trenches cross established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replaced. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials. Removal and replacement of sod shall be done under the direction of an experienced nurseryman.

19. REMOVE AND REPLACE PAVEMENT:

Pavement and base course which must be removed for constructing sewers, manholes, force mains, water lines, and all other appurtenances in streets shall be replaced as specified in Section 321216 or 321313.

a) The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

b) Where utility lines are constructed on unpaved streets, roads or easements, the top 18 inches of soil shall be stripped and windowed separate from the excavation from trenches. After the line has been installed and the backfill completed within 18 inches of the original grade, the salvaged surfacing shall be replaced. This work shall be considered as general clean up along with the removal of surplus excavated materials from the site and the restoring of the surface outside trench limits to its original condition, the cost of which shall be included in the price bid for the utility line.

20. WALKS, DRIVES, CONCRETE CURB AND GUTTER:

Walks and drives removed or damaged during the course of construction shall be replaced with Class "A" Concrete at the same thickness as removed. They will be cut to a neat edge with a masonry saw after backfilling and compacting trench in 6 inch layers to a density not less than 98 percent at ± 2 percent of optimum moisture content as determined by the Standard Proctor Test.

Concrete curb and gutter sections removed or damaged during the course of construction shall be replaced in full sections with concrete having a compressive strength of at least 3,000 psi.

END OF SECTION 312002

SECTION 313116 - TERMITE CONTROL

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. Soil treatment with termiticide.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of termite control product.
 - 1. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For termite control products, from manufacturer.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 - 1. Warranty Period: Three years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum

termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. FMC Corporation, Agricultural Products Group.
 - d. Syngenta.
 - e. Approved equal.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 - 4. Masonry: Treat voids.
 - 5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 321216 – ASPHALT PAVING

1. SCOPE:

Under this heading shall be included the furnishing and installation of base course and pavement as shown including subgrade preparation, base course and pavement.

2. GENERAL:

Subgrade preparation shall include leveling, proof-rolling and compacting of the subgrade as required. Installation of the base course shall include the placing and compacting of the material with appropriate equipment. Pavement shall be placed as shown on the plans with the necessary equipment and shall include any prime coats or tack coats required. All work shall be in conformity with the lines, grades and typical cross- sections shown on the Plans. The Contractor must have all equipment and workers on the job site necessary to perform a given operation when it is initiated.

3. SUBGRADE PREPARATION:

The subgrade shall be brought to the line and grade necessary to accommodate the base and pavement at the required finished grades. All subgrade shall be proof-rolled as specified, before base course is placed on the subgrade.

4. BASE COURSE:

a) Preparation of Base.

The surface of the base course will be inspected by the Engineer for adequate compaction and surface tolerances specified in applicable base course or sub-base course. Any ruts or soft yielding spots that may appear in the base course, any areas having inadequate compaction, and any deviations of the surface from the requirements specified for the base course shall be corrected by loosening the affected areas, by removing unsatisfactory material and adding approved material where required, and by reshaping and recompacting to line and grade and to the specified density requirements. Compaction of base material shall be done by conventional means using a 30,000 to 40,000 pound vibratory roller or other means of obtaining the required compaction.

The lines and grades shown on the Contract Drawings for each pavement category of the Contract shall be established and maintained by means of line and grade stakes placed at the site of the work by the Contractor.

b) Graded Aggregate Base Course.

The aggregate in the base course shall consist of a mixture of either crushed gravel, together with sand, sand-gravel, soil or other materials having similar characteristics combined as necessary to give a mixture conforming to the requirements, prescribed herein. The material and installation shall meet the requirements of Section 310 of the Georgia Department of Transportation Standard Specifications.

<u>Sieve Designation</u>	<u>Percent By Weight Passing</u>	
	<u>Group I</u>	<u>Group II</u>
2"	100	100
1-1/2"	97-100	97-100
3/4"	60-95	60-90
No. 10	25-50	25-45
No. 60	10-35	5-30
No. 200	7-15	4-11

c) Limerock Base Course.

At the Contractor's option limerock of either Miami or Ocala formation may be used, but limerock of only one formation may be used on any contract. Material shall meet the requirements of Georgia Department of Transportation Standard Specification Section 815.2.02 (2001 ed.).

The minimum percentage of carbonates of calcium and magnesium in the limerock material shall be 70. The maximum percentage of water sensitive clay material shall be 3.

The liquid limit shall not exceed 35 and the material shall be non-plastic.

Limerock material shall not contain cherty or other extremely hard pieces, or lumps, balls or pockets of sand or clay size material in sufficient quantity as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

At least 97 percent (by weight) of the material shall pass a 1-1/2 sieve and the material shall be graded uniformly down to dust. The fine material shall consist entirely of dust of fracture. All crushing or breaking up which might be necessary in order to meet such size requirements shall be done before the material is placed on the road.

5. BITUMINOUS PRIME:

Bituminous prime shall be cutback asphalt RC-70, MC-70 or MC-30 applied at the rate of 0.25 gallons per square yards. The material and application shall comply with the applicable portions of the Department of Transportation Standard Specifications and the material and application rate can be adjusted when the applicable section so recommends.

6. BITUMINOUS TACK COAT:

The bituminous tack coat shall be an asphaltic material which meets the requirements of Section 413 of the Georgia Department of Transportation Standard Specifications. Application rate shall be at the rate indicated on the Plans.

7. BITUMINOUS PAVEMENT:

The bituminous wearing surface shall be a plant mix conforming to the requirements of Section 400 of the Georgia Department of Transportation Standard Specifications. The job mix shall meet the requirements of Section 828 of the Georgia Department of Transportation Standard Specifications.

A job mix formula indicating the single definite percentage for each sieve fraction of aggregate and for asphalt shall be submitted prior to surfacing operations. The job mix formula shall also show the percent voids, the percent voids filled with asphalt, and the unit weight per cubic foot of compacted mix.

The general composition limits are extreme ranges of tolerances to govern mixtures made from any raw materials meeting the specifications. The submission of the job mix formula shall bind the Contractor to furnish a paving mixture meeting the exact formula within allowable tolerances of plus or minus 1/2 percent for asphalt, plus or minus 7 percent of 1/2 inch and larger sieve sizes, plus or minus 5 percent for material passing the 1/2 inch sieve and retained on the No. 200, and plus or minus 1/2 percent of material passing the No. 200.

Compaction shall be done with an 8 to 10 ton steel-wheeled roller or other means approved by the Engineer. Thickness shall not vary more than one-fourth inch and smoothness shall not exceed one-eighth inch for a ten foot straight edge.

Base and pavement shall be cored for thickness at points determined by the Owner or his representative, at a minimum of 2 per 500 L.F. (one on edge and one on centerline with edge alternating). In areas of thickness deficiency, additional cores shall be taken as directed by the Owner, and deficiencies shall be remediated to the satisfaction of the Owner without recourse.

8. REMOVE AND REPLACE PAVEMENT:

Pavement and base course which must be removed for constructing sewers, manholes, force mains, water lines, and all other appurtenances in streets shall be replaced with the paving section shown on the drawings or match the existing pavement section. The pavement shall be removed to neat lines cut by a masonry saw. The top 18 inches of subgrade material immediately under the paving base and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

9. TESTING:

The following tests will be made in accordance with the current edition of the appropriate Department of Transportation Standard Specifications.

At least one density determination shall be made for each 900 square yards of base. Asphalt extraction and aggregate gradation on the asphaltic concrete plant mix: one for each 200 tons of material, or fraction thereof, delivered to the job site.

10. PROOF ROLLING:

Proof-rolling will be done with a fully loaded tandem axle dump truck capable of transferring a load in excess of 20 tons. Test rolling will be done parallel to the centerline at speeds between 2 and 5 miles per hour. Areas where pumping, rutting or excessive deflection is observed after successive passes will be undercut, backfilled and properly compacted.

11. PAINTED LINES FOR PARKING AND TRAFFIC AREAS:

Painted lines shall be as shown on the Plans. Paint and all work shall be accordance with Section 652 of the Georgia Department of Transportation Standard Specifications. Glass beads are not required.

The paint manufacturer shall submit a statement which certifies that the paint meets the Department of Transportation specifications. Owner will select the color of paint to be used.

12. SUBGRADE STERILIZATION:

The Engineer will inspect the subgrade before paving. In areas specified by the Engineer, the Contractor will sterilize the subgrade with ½ pound of Parmitol No. 5 PG (manufactured by CIBA-GEIGY) per 100 square feet.

END OF SECTION 321216

SECTION 321313 – CONCRETE PAVING

1. SCOPE:

Under this heading shall be included the construction of concrete pavements.

2. STANDARD SPECIFICATIONS:

All work under this Section shall be performed in accordance with the 2021 edition of the Georgia Department of Transportation "Standard Specifications Construction of Transportation Systems hereinafter referred to as the Standard Specifications, unless specifically changed by the Drawings or the requirements of this Section of the Project Specifications.

3. MATERIALS:

a) Aggregate.

Coarse aggregate shall be crushed stone and shall conform to the requirements of Section 800.2.01 of the Standard Specifications and shall meet the requirements of Class A, Group 1 with respect to wear resistance. Fine aggregate shall conform to Section 801.2 of the Standard Specifications.

b) Cement.

Cement shall conform to the requirements of ASTM C-150, Type I.

c) Water.

Water used in mixing and curing shall be of potable quality.

d) Joint Sealer.

Sealer for joints shall meet the requirements of Section 833 of the Standard Specifications.

e) Joint Filler.

Preformed joint filler shall meet the requirements of Section 833.01 of the Standard Specifications and shall be furnished in a single piece for the full width and depth of the required joint.

f) Dowels and Tie Bars.

Reinforcement for concrete pavements shall meet the requirements of Sections 853.01 and 853.08 of the Standard Specifications.

g) Admixtures.

The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken or proposed for use in the work to determine whether the admixture is uniform in quality with that approved.

1) Air-Entraining Admixtures.

Air-entraining admixtures shall meet the requirements of ASTM C260 and shall be added to the mixer in the amount necessary to produce the specified air content. The air-entrainment agent and the water reducer admixture, if used together, shall be compatible.

2) Water-Reducing Admixtures.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, water-reducing or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

h) Forms.

Forms for use in pavement construction shall be of metal construction, free of dents, bends and warps, and shall be cleaned and oiled prior to each use. Forms shall extend to the full height of the required pavement section and shall be sealed at joints as required to prevent grout loss and to insure a continuous smooth surface on the finished pavement.

i) Curing Agents.

Materials for curing shall conform to the requirements of Section 832 of the Standard Specifications.

4. EQUIPMENT:

Equipment shall meet the requirements of Section 430.3.02 of the Standard Specifications and the additional requirements as specified herein.

5. CONSTRUCTION:

Concrete pavement construction shall be in accordance with Section 430 of the Standard Specifications except as modified herein.

6. PROPORTIONS:

Concrete mixes shall be designed to have the proportions of materials to provide a 28 day minimum flexural strength of 600 psi @ 14 days, an entrained air content of 4.0 to 5.5 percent, a maximum slump of 2.5 inches and a maximum water-cement ratio (lbs./lb.) of 0.53, as required for Class No. 1 in accordance with section 430.3.06 of the Standard Specifications. The Contractor shall submit mix designs which have been verified by laboratory testing and which meet the requirements for strength, air content, water-cement ratio and slump as given above in accordance with Section 430.3.06 of the Standard Specifications. Variations from approved mix designs, for whatever purpose, will be permitted only upon written request by the Contractor and accompanied by new mix designs and the results of verification tests. Water shall not be added to concrete at the site of the work for any reason.

7. JOINTS:

a) Joint Pattern.

The Contractor shall determine the joint pattern which best serves his equipment and operation. Joint spacing shall be within the limits shown on the Drawings except that the ratio of longitudinal to transverse spacing shall not exceed 1.25 and the maximum panel size will be 12-1/2 feet by 15 feet for concrete up to 8 inches thick. This ratio may be exceeded only at those intermediate joints at structure penetrations of the pavement. At such penetrations, an intermediate joint shall be constructed in the transverse direction which has an axis bisecting the penetration center. The Contractor shall submit for approval a jointing plan which includes, but is not limited to, the direction of paving and joint spacing dimensions, the type of joint as designated on the Drawings, the locations and intermediate joint locations at pavement penetrations and the sequence of paving operations. The plan shall be submitted to the Engineer at

such time as required by the Standard Specifications for submittal of mix designs. Slight adjustment in location of drainage inlets will be permitted for the purpose of obtaining efficient joint patterns.

b) Sawed Joints.

The Contractor shall maintain the necessary personnel and equipment on the site at all times to ensure that joints are sawed at the appropriate time. Failure to saw joints at the appropriate stage of concrete set which results in uncontrolled cracking will be cause for the rejection of damaged pavement and such pavement shall be removed and replaced at no additional cost to the Owner.

c) Joint Filler.

Elastomeric joint filler shall only be placed on clean surfaces. All joint filler material yielded outside the joint and all over runs shall be removed.

8. FINISHING:

The surface shall have a broom finish in accordance with Section 430 of the Standard Specifications.

9. CURING:

a) Requirements.

Curing shall be in accordance with Section 430 of the Standard Specifications except that for hot weather concreting, the use of burlap cover maintained in a wet condition for 7 days shall be required.

b) Control.

The Contractor shall maintain the necessary personnel and equipment on the site at all times to ensure that curing is initiated at the proper stage of concrete set. Uncontrolled cracking resulting from improper or untimely curing will be cause for rejection of the work and the removal and replacement of pavement at no additional cost to the Owner.

10. TESTING:

a) General.

All testing for quality assurance will be performed by a laboratory retained by Owner.

b) Strength.

Flexure testing shall be performed in accordance with AASHTO: T 126 and T 97. Each set for field control shall consist of 3 beam specimens obtained during concrete placement operations and 6 cylinders from the same load of material. Cylinders shall be tested in accordance with ASTM C496. Where adequate correlation is obtained, the Engineer may allow use of cylinders in place of beam testing.

c) Frequency.

The following table presents the minimum testing intervals for all concrete testing. The intervals may be increased during the work at the direction of the Engineer.

<u>TEST</u>	<u>FREQUENCY</u>
Flexure	One set per 800 square yards
Slump	One per each 3 delivery vehicles
Entrained Air	One per each 3 delivery vehicles
Density	One per each 5 delivery vehicles

12. CRACK CONTROL:

The Contractor shall have total responsibility for the prevention of uncontrolled cracking of pavements from any cause. Cracks in pavements shall be repaired by removal and replacement of concrete pavement at no cost to the Owner. Cracks that occur within 2 feet of a joint for their total length shall be repaired by removal and replacement of concrete pavement between the crack and the adjacent joint. Other cracks shall be repaired by total removal and replacement of all pavement within the panel formed by adjacent joints. Subgrade repair made necessary by corrective operations shall be performed at no cost to the Owner. In the event that uncontrolled cracking occurs in two or more adjacent panels oriented in the direction of paving, the Contractor shall cease all placement of concrete and shall determine the cause. Upon determination of the cause, the Contractor shall submit to the Engineer such modifications to operations and/or materials as may be required to prevent additional cracking.

13. PAINTED STRIPES:

Parking and traffic stripes shall be installed in accordance with Section 652 of the Standard Specifications. Certification by the manufacturer that the paint to be used meets all requirements of the Specifications shall be submitted to the Engineer prior to any application.

14. USE:

The pavement shall be released to the Owner for use in completed condition at the end of the contract period. Such completion time shall include 28 days for curing. Use by the Owner will not constitute final acceptance for payment.

END OF SECTION 321313

SECTION 321314 – CONCRETE SIDEWALKS, CURB AND GUTTER

1. SCOPE:

Under this heading shall be included the construction of all concrete sidewalks, curb and gutter.

2. CONCRETE:

Concrete shall be composed of cement, admixtures, fine aggregate, coarse aggregate, and water proportioned and mixed to produce a plastic workable mix in accordance with the requirements of American Concrete Institute (ACI) Manual of Concrete Practice-1980 (MCP), and shall be suitable for the specific conditions of placement. Concrete shall be Class "A" per Georgia DOT Standard Specification Section 500.1.03 and shall have 28-day compressive strength of not less than 3,000 psi, and contain not less than 611 pounds of cement per cubic yard of concrete. The maximum size of coarse, hard aggregate shall be 3/4-inch.

All concrete shall be ready mixed concrete in accordance with ASTM C94. All reinforcement shall comply with ASTM A615.

3. PREPARATION:

Before placing concrete, all debris and water shall be removed from the places to be occupied by the concrete. Wood forms shall be thoroughly wetted or oiled, and the reinforcement cleaned of coatings. Formwork and the placement of reinforcement, pipes, anchors and other inserts shall be inspected by the Engineer before any concrete is deposited.

4. PLACING:

The placing and depositing of all concrete shall be done in accordance with requirements of the ACI. Concrete shall be rapidly handled from mixer to forms and deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be allowed to drop freely more than 4 feet. For greater drop a tremie or other means must be used. Concrete shall be spaced and worked by hand and vibrated to assure close contact with all surfaces of forms and reinforcement and leveled off at proper grade to receive finish. No concrete that has partially hardened or been contaminated by foreign material shall be deposited in the work. Concrete shall never be deposited upon soft mud or dry porous earth.

5. VIBRATION:

Concrete shall be placed with the aid of manual vibration. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place, but shall not be long enough to cause segregation of the mix. To secure even and dense surfaces, vibration shall be supplemented by hand spading in the corners and angles of forms and along form surfaces while the concrete is plastic under the vibratory action. Caution must be exercised to prevent any injury to the inside face of the forms or any movement of the reinforcement.

6. CONSTRUCTION JOINTS, CONTROL JOINTS AND EXPANSION JOINTS:

Joints shall be formed and located as indicated on the Plans, or as recommended by applicable requirements of MCP. Final locations are subject to Engineer's review.

The rate and method of placing concrete and the arrangement of construction joint bulkheads shall be such that the concrete between construction joints shall be placed in a continuous operation. Whenever it is necessary to stop work, such stops shall be located and temporary bulkheads erected. Before concreting is

resumed, the surfaces of previously placed concrete shall be roughened, cleaned, wetted and slushed with grout immediately before additional concrete is placed. Grout shall be one part Portland Cement and two parts sand.

Expansion joints shall be provided in walks, and curb and gutter where shown and at walls, intersecting walks and buildings. Expansion joints in walks and curb and gutter shall be made with 1/2 inch thick premolded, non-extruding expansion joint filler, "Flexcell," or "Meadows" or equal, extending through the full thickness of the concrete except the upper 1/4 inch at 50 foot intervals. When sidewalk is adjacent to curb the expansion joints shall coincide. These shall be set accurately in place to straight lines and concreted in. Control joints in sidewalks shall be spaced at intervals equal to the width of the sidewalk and in curb and gutter at 10 foot intervals. Edges of grooves, expansion joints and edges of walks and curb and gutter shall be rounded to a 1/4 inch radius with suitable grooving and edging tools.

7. FINISHING:

Walks and curb and gutter shall be finished as specified for troweled concrete except that final finishing shall be with wood floats or broomed, as directed, to produce non-slippery finish at right angles to the length unless otherwise directed. Completed work shall be finished true to line and grade and when tested with a 10 foot straightedge shall not show a variation of more than 1/4 inch from a straight line.

8. PROTECTION AND CURING:

Protect concrete against frost, freezing temperatures, rapid drying and heavy rain after placing during this period, concrete shall be maintained above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days.

Walks and other exterior concrete shall be cured by covering first with sprayed-on curing compound applied immediately after finishing and then also completely covered with an impermeable fiber filled paper for a period of not less than 72 hours.

Membrane curing compound shall comply with ASTM C309 for Type I and paper shall comply with ASTM C171.

Exterior concrete work constructed during hot weather shall be protected, in addition to the curing specified above, with Spencer Kellogg Anti-Spalling Compound, or Carter-Waters "Dek-Seal," or equal, applied as soon as conditions will permit after curing and when the concrete is clean and dry. The mixture shall be applied uniformly in 2 applications, in accordance with the manufacturer's recommendations. The second application shall not be made until after the first coat has been completely absorbed by the concrete.

9. REMOVAL OF FORMS:

Care shall be taken in the removal of the forms not to damage the surface of the concrete. Immediately after the forms are removed, all damaged or imperfect work shall be patched in a neat and workmanlike manner, or if badly damaged or imperfect, the work shall be rebuilt. Leave shoring in place until concrete member will support its own weight safely plus any loads that may be placed upon it.

Freshly stripped surfaces shall not be pointed up or touched in any manner before having been inspected by the Engineer.

10. PATCHING AND FINISHING CONCRETE FORMED SURFACES:

Immediately after removing forms, all concrete surfaces shall be inspected, and any honeycomb, voids, stone pockets, and tie holes shall be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 1 inch with the edges perpendicular to the surface. The area to be patched and a space of at least 6 inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. The patch shall be finished in such a manner as to match the adjoining surface.

Immediately upon removing forms from finished concrete surfaces, they shall be cleaned of all cement fins and any air pockets shall be carefully filled with cement mortar worked in to insure a bond with the concrete and finished off to match the surrounding surface.

All vertical exterior surfaces exposed in the finished work shall be finished to a smooth rubbed finish having a uniform appearance.

END OF SECTION 321314

SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes planting soils specified according to performance requirements of the mixes.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.

1.2 DEFINITIONS

- A. CEC: Cation exchange capacity.
- B. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- C. Imported Soil: Soil that is transported to Project site for use.
- D. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- E. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- F. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- H. SSSA: Soil Science Society of America.
- I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- J. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- K. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

- L. USCC: U.S. Composting Council.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site at a time designated by project Landscape Architect.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each bulk-supplied material in sealed containers labeled with content, source, and date obtained; providing an accurate representation of composition, color, and texture.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed such as the University of Georgia Cooperative Extension:

Soil, Plant, and Water Analysis Laboratory (SPW)
2400 College Station Road
Athens, Georgia 30602-9105
phone: 706-542-5350
fax: 706-369-5734

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

- A. Existing, on-site surface soil, with the duff layer, if any, retained and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:
 1. 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6 to 7.
 2. On-site soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the soil.

- c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.
 - 3. Percentage of Organic Matter: Minimum 5 percent by volume.
- B. Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:
 - 1. 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6 to 7.
 - 2. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
 - 3. Additional Properties of Imported Soil before Amending: Minimum of 5 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.
- C. Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials as specified in other articles of this Section to produce viable planting soil.
 - 1. Basic Properties: 45% sand, 40% silt 10% clay and 5% organic material with a pH of 6-7.
 - 2. Manufactured soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches (50 mm) in any dimension.

3. Percentage of Organic Matter: Minimum 5 percent by volume.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.
- E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance,".
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Spread unamended soil to depth required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer required by soil test for plants specified evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur as required with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
- D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests:
 - 1. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
- C. Soil will be considered defective if it does not pass tests.
- D. Prepare test reports.

- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.4 PROTECTION AND CLEANING

- A. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329115

SECTION 329200 – TURF AND GRASSES

1. SCOPE:

This section includes topsoiling, fertilizing, grassing and sodding. In case of conflict between requirements of this Section and the Landscaping Plan, the Landscaping Plan requirements shall govern.

2. GENERAL:

All disturbed areas resulting from work under this Contract shall be grassed. For roads under state jurisdiction, grassing on the right-of-way shall meet the requirements of the Department of Transportation Standard Specifications. The limits of sodding are shown on the Plans.

When the amount of grassing exceeds one acre, samples shall be taken and analyzed for pH, calcium, magnesium and Soil Fertility needs. The analyses shall be the basis for determining the composition and application rate of the fertilizer and lime, and possible varieties of grass. When these tests are taken the results shall be submitted to the Engineer.

3. TOPSOILING:

Topsoil shall be placed 4 inches to 6 inches deep over all areas to be grassed, using salvaged topsoil to the extent possible and topsoil from offsite borrow to supplement that salvaged. Topsoil shall be natural soil of the region, free from lumps, clay, toxic substance, sticks, debris, vegetation, stones over 1 inch in maximum dimension, and suitable for growing grass. Topsoil shall be spread over the areas to be grassed and shall be fine graded so as to be suitable for sowing.

4. FERTILIZING:

a) Material.

All areas to be grassed or sodded shall have fertilizer and lime applied as specified or as determined by the soil analyses.

Fertilizer shall be of such composition that when uniformly applied it will furnish not less than the following quantities of available plant food per 1,000 square feet:

Nitrogen	1.0 pounds
Phosphoric Acid	1.0 pounds
Potash	1.0 pounds

This is equivalent to a commercial 10-10-10 fertilizer. Commercial fertilizer blends which will give fractions exceeding these will be accepted, provided that no fraction exceeds the required by more than 2 times. The fertilizer shall be delivered to the job in original, unopened containers.

5. SEEDING:

Seed shall be delivered in suitable sealed containers labeled in accordance with applicable laws and regulations and including name and location of the producer. The pure live grass seed mixture shall be as follows:

a) Mixtures for Spring and Summer Planting-March 1 to September 1.

Bermuda, hulled 10 lbs/acre (March – June)
(Cynodon
dactylon)

Bermuda, unhulled
(Cynodon dactylon) 10 lbs/acre (July – August)

b) Mixtures for Fall and Winter Planting-September 1 to March 1.

Annual
Rye Grass 40 lbs/acre
(Lolium
Temulentum)

OR

Bermuda (Unhulled)
(Cynodon
dactylon) 10 lb/acre

Rye 30 lb/acre
(Secale cereale)

c) Application.

Seeds are to be sown by a mechanical spreader either hand operated or machine operated. Seeding equipment shall be such as will continuously mix the seeds to prevent segregation.

d) Soil Preparation.

Immediately before seeding, the soil shall have been properly prepared for seeding. Immediately after the seed has been sown, the entire area shall be raked lightly and rolled lightly to pack the soil firmly around the seed.

Seeded areas shall be moist when seeding and shall be kept moist by sprinkling until a good stand of grass is obtained (minimum of two weeks) and until the work is accepted by the Owner. Reseeding shall be done by the Contractor at his own expense as may be necessary to obtain a satisfactory stand of grass.

The Contractor shall use mulch or other additive materials when conditions do not allow an acceptable stand of grass to grow. Mulch and additive materials shall contain no weed seeds.

6. SODDING:

a) Material.

Sod shall be good quality, densely-rooted Bermuda or centipede grass, free from noxious weeds. The sod shall be obtained from areas where soil is reasonably fertile and contains a high percentage of loamy topsoil. Before cutting, the sod shall be raked free of all debris and the grass cut to two inches. The thickness of the sod shall be such as to contain practically all of the dense root system of the grass not less

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than 1-1/2 inches. Sod shall be cut in uniform strips not less than 12 inches and not less than 24 inches in length, and shall be placed within 48 hours of cutting.

b) Application.

Sod will be placed between January 15th and December 1st.

c) Soil Preparation.

Ground shall be prepared by excavating and turning to a depth of at least 4 inches. Fertilizer and lime shall be placed uniformly on the loosened soil then mixed in by means of a handrake or spike tooth harrow. The surface shall then be smoothed to accept the sod.

d) Placing Sod.

Sod shall be moist when laid and placed on a moist bed. The sod strips shall be carefully placed by hand, beginning at the toe of slopes and progressing upward, with the length of the strip at right angles to the direction of flow of surface water. All joints shall be tightly butted and end joints shall be staggered at least 12 inches. The sod shall be immediately pressed firmly into contact with bed by tamping or rolling. Screened soil shall be used to fill all joints between strips.

Sod on slopes shall be pegged with sod pegs to prevent displacement. Sod shall extend 18-inches over crest of slope. The sod shall be watered (minimum of 2 weeks), mowed, weeded, repaired or otherwise tended to insure the establishment of a uniform healthy stand of grass.

7. MAINTENANCE AND RESEEDING:

All seeded and sodded areas shall be maintained without additional payment until acceptance of the Contract and any regrading, refertilizing, reseeding or resodding shall be done at the Contractor's expense. Any areas which fail to show a "catch" or uniform stand, for any reason whatever, shall be reseeded or resodded with the original mixture, and such reseeding or resodding shall be repeated until final acceptance. The Contractor shall properly water, mow, and otherwise maintain all seeded and sodded areas until final acceptance.

Damage resulting from erosion, gulleys, washouts, or other causes shall be repaired by filling with topsoil, tamping, refertilizing, and reseeding or resodding by the Contractor at his expense if such damage occurs prior to acceptance of the Contract.

8. SUBMITTAL:

Manufacturer's data shall be submitted to the Engineer on grass seed, sod and fertilizer before the materials are delivered to the project site.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plants.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- C. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.
- D. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site at a time designated by project Landscape Architect.

1.4 ACTION SUBMITTALS

- A. Product Data:
 1. Picture (with measuring stick near plant material) and nursery supplier of all plants will be provided to the Landscape Architect for approval prior to purchase or delivery.
- B. Samples of mulch.
- C. Product certificates.

- D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.6 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- C. Handle planting stock by root ball.
- D. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
2. Warranty Periods: From date of planting completion.
- a. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months.
 - b. Ground Covers, Perennials, and Other Plants: 24 months.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

- A. Organic Mulch: Pine bark nuggets or Pine Straw

2.4 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation (Performance Specification)."
- B. Placing Planting Soil: Blend planting soil in place.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter.
 - 3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil if it has been modified per Section 329115 "Soil Preparation (Performance Specification)."

3.3 TREE, SHRUB, AND ORNAMENTAL GRASS PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: Planting soil per Section 329115"Soil Preparation (Performance Specification)."
 2. Balled and Burlapped Stock: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Container-Grown Stock: Carefully remove root ball from container without damaging root ball or plant.
 4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
 - a. Bare-Root Stock: Place tablets beside soil-covered roots; do not place tablets touching the roots.
 - b. Quantity: Three per plant.
 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE AND SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- C. Do not apply pruning paint to wounds.

3.5 GROUND COVER PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil per Section 329115"Soil Preparation (Performance Specification)" for backfill.
- C. Dig holes large enough to allow spreading of roots.

- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

- A. Install weed-control barriers (if desired by owner) before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs: Apply organic mulch ring of 3-inch (50-mm) average thickness, with radius as shown on plans around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) average thickness of organic mulch over whole surface of planting area and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.7 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

- F. At time of Substantial Completion, verify that irrigation system is in good working order and replace improperly functioning devices.

3.8 MAINTENANCE SERVICE

- A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period for Trees and Shrubs: 24 months from date of Substantial Completion.
 - 2. Maintenance Period for Ground Cover and Other Plants: 24 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 333400 – SANITARY UTILITY SEWERAGE FORCE MAINS

1. SCOPE:

This section covers the installation of sanitary sewer forcemains including excavation, pipe laying, backfilling, compaction and other work.

2. EXCAVATION AND BACKFILL:

Excavation and backfilling shall be as specified in Section 312002, Excavation, Trenching and Backfill for Utility Systems. A minimum cover over the top of the pipe of three feet from the proposed subgrade, shoulder or finished grade shall be provided.

3. PIPE MATERIALS

Except where specifically noted on the Drawings, the following types of pipe shall be used:

a) Ductile Iron Pipe

1. Material

a. Ductile iron pipe shall be manufactured in accordance with ANSI A21.51, latest revision. Ductile iron pipe shall be of the thickness according to ANSI A21.50, latest revision, for Laying Condition Type 2.

b. Flange Pipe or Victaulic grooved pipe shall be Pressure Class 350.

2. Fittings

a. Fittings shall conform to ANSI/AWWA C111 A21.11, latest revision, and shall be push-on-type unless otherwise shown.

b. Mechanical joint fittings shall conform to ANSI/AWWA C153/A21.53, latest revision. Bolts shall conform to ANSI B18.2.1, latest revision. Nuts shall conform to ANSI B-18.2.2, latest revision. Bolts and nuts shall conform to ANSI B1.1.

c. Flanged Fittings shall conform to ANSI /AWWA C110/A21.10, latest revision. The ANSI/AWWA C110/A21.10 fitting flanges shall have facing and drilling which match ANSI/AWWA C115/A21.15 threaded-on flanges which also match ANSI B16.1 Class 125 flanges except where Pressure Class 250 is noted.

3. Joints

a. Joints shall conform to ANSI A21.11, latest revision, push-on-type unless otherwise shown.

b. Restrained Joints - Restrained joints for pipe, valves and fittings shall be mechanical joints with ductile iron retainer glands equivalent to Ford 1390 Series, Mega-Lug, EBBA

Series 1100 for Ductile Iron 4" and larger, EBBA Series 2000 PV for PVC Pipe 4" and larger, Flexlock, T-lock, Uni-Flange, or approved equal or push on joints equivalent to "Lock Ring", "TR Flex", "Super Lock", "Field Lock", or "MJ FIELD LOK Gasket, Series DI or Series PV" The joints shall be in accordance with the applicable portions of ANSI/AWWA C111/A21.11.

4. Lining

Lining for the interior of ductile iron pipe and fittings shall be 40 mils nominal dry film thickness of ceramic epoxy, conforming to ASTM E-96-66, ASTM B-117, ASTM 6-95, ASTM D-714-87, latest revision. Ceramic epoxy shall be Protecto 401, or equal. Lining application, inspection, certification, handling and surface preparation of the area to receive the protective coating shall be in accordance with the manufacturer's specifications and requirements.

5. Exterior Coating

Exterior coating shall be an approved bituminous coating 1 mil thick in accordance with ANSI A21.51, latest revision.

6. Polyethylene Encasement

Polyethylene encasement shall conform to ANSI A21.5, latest revision for high density, cross-laminated polyethylene film. Polyethylene encasement shall be used and installed according to the requirements of ANSI A21.5, Sec. 4.4, Method A and where indicated on the drawings.

b) PVC Pipe

PVC force main pipe shall be factory dyed industry standard **green** in color.

1. Material

a. PVC Pipe for sewer force mains 4-inches through 12-inches shall conform to AWWA C900, DR 25, latest revision and pipe 14-inches and larger shall conform to AWWA C905, DR 25 unless specifically shown otherwise on the Drawings.

b. Pipe less than 4 inches in diameter shall be Class 200 with dimension ratio of 21 or lower conforming to ASTM D2241, latest revision.

2. Outside Diameter

Pipe shall have an outside diameter equal to the outside diameter of ductile iron pipe.

3. Joints

PVC pipe joints shall have integral bell and spigot joints with elastomeric gasket conforming to ASTM F477, latest revision, integral thickened wall bell end. Gasket groove wall thickness shall meet or exceed the thickness of the pipe barrel.

4. Fittings

Fittings on 3-inch and larger pipe shall be ceramic epoxy lined ductile iron conform to ANSI/AWWA C-153/ A21.53, latest revision.

PVC fittings may be used on 2-inch pipe.

5. Couplings and Fittings

Couplings and fittings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are to be used. They shall have the same minimum pressure rating as the pipe. Coupling method shall allow for expansion or contraction of each pipe section to be taken up at each end of the pipe.

6. Affidavit of Compliance

The manufacturer shall furnish an affidavit that all materials delivered comply with the requirements of this standard and supplemental specification.

c) Polyethylene Pipe

High Density Polyethylene (HDPE)

Pipe supplied under this section shall be, SDR-11. It shall meet the criteria for a Type III, Class C, Category 5, Grade PE34 piping material in accordance with ASTM D3350.

1. Dimensional characteristics and pressure capabilities shall meet the requirements of ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for PE Plastic Pipe and Tubing; ASTM D2513 and AWWA C906-99, Polyethylene (PE) Pressure Pipe and Fittings.

2. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed according to the manufacturer's recommendations.

3. End connections 12-inch and larger shall be flanged ends. Less than 12-inches may be flanged or MJ adapters with insert sleeves.

4. VALVES

a) Plug Valves

Plug valves shall be used on all sewer applications unless approved otherwise by the Engineer. Plug valves shall be of the non-lubricated eccentric plug type with a resilient seat seal. Plug valves for buried service shall be furnished with mechanical joint ends in accordance with ANSI Standard A21.11, latest revision. Plug valves located in valve vaults or above ground shall be furnished with flanged ends in accordance with ANSI 16.1, Class 125/150 standard faced and drilled. Port area for all valves shall be a minimum of 80% of the full pipe area. Valve bodies shall be of ASTM A-126 Class B cast iron. All exposed nuts, bolts, washers, springs, etc. shall be stainless steel.

Plug facing shall be non-metallic. The seat shall be nickel and welded to the body of the valve. Valves shall have their internal wetted surfaced protected by nonmetallic coatings factory applied, thermally bonded and in full conformance to AWWA Standard C550, latest revision.

Nominal valve pressure ratings, body flanges and wall thicknesses shall be in full conformance to ANSI B16.1. Valves shall seal leak-tight against full rated pressure in both directions.

Valves two inches (2") and larger for direct bury shall have gear actuators with 2" square operating nut and shall be capable of opening valve at rated pressure of 150 psi. All gearing shall be fully enclosed in a suitable housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. A suitable stop shall be set to provide water tight shut off in the closed position at full rated pressure. All exposed nuts, bolts and washers shall be stainless steel.

Valve actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs, and washer used in buried service shall be stainless steel.

Plug valves shall be Dezurik Eccentric Plug Valves or an approved equal and shall be installed as shown on the Drawings.

b) Sewage Combination Air Valves.

All valves shall be supplied with back-flushing attachment and hose. Body shall be cast iron of the long body design conforming to ASTM A48, Class 35 and shall be able to operate at pressures up to 300 psi with all internal parts and floats of stainless steel. The open vent end of the air release valve shall have an air relief pipe from automatic valves or from a manually operated valves that shall be extended to the top of the pit and provided with a screened downward facing elbow. Sewage combination air valves shall be provided at points shown on the force main and shall be 2 inch size unless noted otherwise. The valves shall be capable of venting air from the pipeline while filling, permit air to reenter the pipeline to reduce the potential for vacuum on the system, and release air from the pipeline while the pipeline is pressurized. Valves shall be APCO Series 440 SCAV, Empire Figure #942, or equal.

5. INSTALLATION

a) Pipe and fittings shall, unless otherwise directed, be unloaded at the point of delivery, hauled to and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. In loading and unloading, they shall be lifted by hoists or slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handling on skidways must not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

Cutting pipe for inserting fittings, or closure pieces, shall be done in a neat and workmanlike manner without damage to the pipe. Wherever necessary to deflect the pipe from straight line, whether in the vertical or horizontal direction to avoid obstructions, the degree of deflection shall be in accordance with manufacturer's instructions. No pipe shall be laid in water or when the trench condition or the weather is unsuitable for such work. Installation shall be in accordance with manufacturer's instructions.

b) Ductile Iron Pipe

Proper implements, tools and facilities shall be provided and used by the Contractor for the safe prosecution of the work. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of derrick, ropes or other suitable tools or equipment in such a manner as to prevent damage to the pipe. Under no circumstances shall pipe or accessories be dropped into the trench. Before lowering and while suspended, pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected. All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying.

Care shall be taken to prevent dirt from entering the joint space. At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter the pipe.

c) PVC Pipe

Pipe shall be installed in accordance with ASTM D2321, latest revision. Excavation, bedding and backfill shall be as specified in Section 312002.

d) Polyethelene Pipe

Pipe shall be installed in accordance with ASTM D2321, latest revision. Excavation, bedding and backfill shall be as specified in Section 312002.

6. HYDROSTATIC TESTING:

a) All pressure and leakage test shall be performed in accordance with the latest edition of AWWA C600. Leakage test may be conducted simultaneously with the pressure test. The duration of the test shall be 2 hours and during the test the main or section of main under test shall be subjected to a pressure of 100 psi based on the lowest point in the line or section under test, and connected at that elevation to the test gauge. Test pressure shall not vary more than 5 psi for the duration of the test. Testing allowance shall be defined as the quantity of makeup water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the test pressure after the pipe has been filled with water and the air has been expelled Testing allowance shall not be measured by a drop in pressure in a test section over a period of time. Testing allowance is defined as the quantity of water to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the specified leakage test pressure after the air has been expelled and the pipe has been filled with water at the test pressure. No pipe installation will be accepted until the testing allowance is less than the number of gallons per hour as determined by the formula.

$$L = \frac{S \times D \times P}{148,000}$$

L = testing allowance (makeup water), in gallons per hour

S = the length of pipe tested in linear feet.

D = the nominal diameter of the pipe in inches

P = the average test pressure during the hydrostatic test in pounds per square inch (gauge).

b) Should any test of pipe laid disclose leakage greater than the above specified, the Contractor shall at his own expense locate and repair the defective joints until leakage is within the specified testing allowance. All visible leaks shall be repaired regardless of the allowance used for testing. Line shall be retested until testing allowance requirement are within the allowable leakage. All testing shall be at the Contractor's expense.

7. MANHOLES

a) Precast Concrete manholes shall meet all of the requirements of Specification Section 221313, Facility Sanitary Sewers.

b) New manholes that receive flow from sewer force mains shall be completely lined (top, bottom, and sides) with ConSeal CS-55, colors gray or black, as manufactured by Concrete Sealants, New Carlisle, Ohio or equal. Coating shall be in accordance with manufacturer's recommendations. The coating manufacturer and applicator shall inspect and certify all coatings prior to the coated precast structures leaving the precast facility.

c) Existing manholes that receive flow from sewer force mains shall be completely lined (top, bottom, and sides) with polyurethane or solid epoxy, light in color, 15,000 psi compressive strength, 1,500 psi tensile strength, hardness Type D 60, bond strength greater than the tensile strength of concrete, dry fil thickness 125 mils.

d) Connection to existing manholes shall be by coring and placement of a flexible boot of proper size for the pipe diameter. Flexible pipe to manhole connector shall accommodate both angular and lateral misalignment and shall conform to ASTM C923 specifications. All pipe clamp bands and expansion bands shall be stainless steel. Flexible connectors shall be Lock Joint, Kor-N-Seal II, or equal.

8. MYLAR TAPE AND WIRE

a) Mylar Tape

Mylar maintenance tape shall be installed 18-inches below finished grade and on top of the trench above all force mains where non-metallic pipe is used. The tape shall be 2 inches wide, of **green** color and have imprinted on the tape "Caution-Force Main Below". The tape shall be laid the entire length of the trench.

b) Wire

No. 12 AWG solid plastic-coated single strand copper wire shall be attached to the top of all force mains with duct tape where non-metallic pipe is used. The wire shall be laid the entire length of the trench and shall be continuous. The Contractor shall demonstrate continuity in wire through the entire length of the project. The tracer wire shall be run up and be securely attached at an exposed point and at each end. Wire shall be bonded at splices with 3M DBY-6 Direct Bury Splice Kit at every connection. The Owner will test all tracer wires in the system prior to acceptance.

9. UTILITY MARKING POST

Utility marking post shall be placed every 500 feet, at all change of direction or as shown on the Drawings above the utility and at fittings and labeled accordingly. The marking post shall be rigid enough to be easily installed in most soil conditions and durable to withstand repeated impacts. The marking post shall be four (4) inches in width and remain flexible from -40E F to +140EF with UV stabilizers. The marker shall be of highly visible standard fade resistant colors, White Background and Green Lettering with the following imprinted thereon: international No Dig symbol, federal law warning, "FORCE MAIN BELOW" with letter size and stroke to comply with the Federal Office of Pipeline Safety Specifications, system owner's name, phone number and State one-call number. Markers shall be Rhino 3-Rail with poly tech coating or approved equal. The #12 gauge wire shall be run to each marker from the underground utility, wrapped around each marker several times at finished grade.

10. RECORD DRAWINGS

The Contractor shall provide Record Drawings seventy-two (72) hours before final inspection will be made. The Contractor shall keep on the work site one (1) set of clean plans on which at the end of every day the necessary information will be marked by the Contractor's superintendent. All deviations from the plans shall be stationed and clearly marked. Record drawings shall include measurements between each valve, bends, permanent landmarks, manholes, and profile information.

11. SHOP DRAWINGS

Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified herein.

END OF SECTION 333400

SECTION 334000 – STORM DRAINAGE UTILITIES

1. SCOPE:

Under this heading shall be included all operations in connection with the installation of the storm drainage system.

2. EXCAVATION AND BACKFILL:

Excavation and backfilling shall be as specified in Section 312002, Excavation, Trenching and Backfill for Utility Systems.

3. DELIVERY, STORAGE, AND HANDLING OF MATERIALS:

a) Delivery and Storage.

Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

b) Handling.

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried to the trench, not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

4. PIPE FOR CULVERTS AND STORM DRAINS:

Pipe for culverts and storm drains shall be as indicated and shall conform to requirements for the following types.

a) Concrete Pipe.

Except where noted pipe 12 inches and larger shall be reinforced concrete pipe conforming to ASTM C76, Class III. Pipe smaller than 12 inches shall be non-reinforced concrete pipe conforming to ASTM C14.

1) Joints.

Joints shall be made by use of a continuous rubber gasket conforming to the requirements of ASTM C443. Type II or III rubber gaskets shall be used on the pipe. Joints which do not fit tightly and uniformly shall be grouted after that segment of the line has been installed. All joints under pavement shall be wrapped with a two foot wide strip of non-woven filter fabric lapped two feet.

The assembly of the gasketed joint shall be performed as recommended by the pipe manufacturer. The elastomeric gaskets may be supplied separately in cartons or prepositioned in the bell joint or coupling at the factory. In all cases, clean the gasket, the bell or coupling interior, especially the groove spigot area to remove any dirt or foreign material before assembling. Inspect the gasket, pipe spigot bevel, gasket groove, and seating surfaces for damage or deformation. When gaskets are separate, use only gaskets which are designed for and supplied with the pipe. Insert them as recommended by the manufacturer.

Lubricant should be applied as specified by the pipe manufacturer. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly.

b) Corrugated Polyethylene Pipe.

Shall be high density polyethylene corrugated pipe with an integrally formed smooth interior. Corrugations shall be annular.

Pipe shall be made of polyethylene compounds which conform to the requirements of Cell class 335420C (min.) as defined and described in ASTM D-3350, except that carbon black shall not exceed 5%. Requirements for test methods, dimensions, and markings are those found in AASHTO Designations M-252 and M-294.

Minimum parallel plate pipe stiffness values shall be as follows:

<u>Diameter</u>	<u>Pipe Stiffness*</u>
12" and less	50 psi
15"	42 psi
18"	40 psi
24"	34 psi
30"	28 psi
36"	22 psi
42"	19 psi
48"	17 psi
60"	14 psi

*Per ASTM Test Method D-2412

Joints shall be integral bell and spigot with a gasket on the spigot end. Gasket material shall meet ASTM F-477.

Installation shall be in accordance with ASTM Recommended Practice D-2321 or as specified by the Project Engineer or local approving agency.

A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Project Engineer upon request.

c) Corrugated Steel Pipe and Pipe Arch.

Corrugated steel pipe shall be helically fabricated utilizing welded seam construction. Pipe will have 2 annular corrugations rerolled into each end of each piece of pipe.

1) Bituminous Coated.

Pipe shall be fully bituminous coated, double dipped in strict accordance with AASHTO M190. The base metal shall conform to the requirements of outlined in ASTM A444 for chemistry, weight of galvanizing and permissible variations in dimensions.

2) Aluminized Steel.

Aluminum coated corrugated steel pipe shall be Aluminized Type 2 and may be equally substituted for asphalt fully bituminous coated galvanized corrugated steel pipe.

The sheets and coils from which the aluminum coated corrugated steel pipe is produced shall be coated in a bath of commercially pure aluminum by the continuous hot dip method to a coating weight of 1 ounce per square foot. The base metal shall conform to the requirements of ASTM A525. The pipe shall meet the requirements of AASHTO 2.74 - 2.79 and AASHTO M36.

3) Pipe Size and Gauge.

a. Circular Pipe.

<u>Pipe Diameter</u>	<u>Thickness</u>	<u>Corrugation</u>	<u>Gauge</u>
12" to 24"	.064"	2-2/3 x 1/2	16
30" to 42"	.079"	2-2/3 x 1/2	14
48" to 60"	.109"	2-2/3 x 1/2	12
36" to 60"	.064"	3 x 1	16

b. Pipe Arch.

<u>Span Rise</u>	<u>Thickness</u>	<u>Corrugation</u>	<u>Gauge</u>
17"x13"	.064	2-2/3 x 1/2	16
21"x15"	.064	2-2/3 x 1/2	16
24"x18"	.064	2-2/3 x 1/2	16
28"x20"	.064	2-2/3 x 1/2	16
35"x24"	.064	2-2/3 x 1/2	16
40"x31"	.079	3 x 1	14
42"x29"	.064	2-2/3 x 1/2	16
46"x36"	.079	3 x 1	14
49"x33"	.079	2-2/3 x 1/2	14
53"x41"	.079	3 x 1	14
57"x38"	.109	2-2/3 x 1/2	12
60"x46"	.079	3 x 1	14
64"x43"	.109	2-2/3 x 1/2	12
66"x51"	.079	3 x 1	14
73"x55"	.079	3 x 1	14

4) Joints.

Joints shall be made utilizing standard corrugated bands or proprietary banded joint employing rolled-in annular corrugations to accommodate the annular corrugations on the pipe ends and provide for O-ring gaskets. The banded joint shall be approximately 10 inches wide and equipped with bar and strap connectors with two 1/2 inch diameter band bolts. The joint shall be self centering. Dimple bands will not be permitted.

d) Corrugated Aluminum Pipe and Pipe Arch.

Shall be Helical and conform to AASHTO M196 with the following thicknesses:

1) Circular Pipe.

<u>Pipe Diameter</u>	<u>Thickness</u>	<u>Corrugation</u>	<u>Gauge</u>
15"	.060"	2-2/3 x 1/2	16
18" to 24"	.075"	2-2/3 x 1/2	14

30" to 36"	.105"	2-2/3 x 1/2	12
30" to 36"	.075"	3 x 1	14
42" to 54"	.135"	2-2/3 x 1/2	10
42" to 54"	.075"	3 x 1	14
48" to 72"	.105"	3 x 1	12

2) Pipe Arch.

<u>Span Rise</u>	<u>Thickness</u>	<u>Corrugation</u>	<u>Gauge</u>
17"x13"	.075"	2-2/3 x 1/2	14
21"x15" to 24"x18"	.105"	2-2/3 x 1/2	12
28"x20"	.135"	2-2/3 x 1/2	10
35"x24"	.135"	2-2/3 x 1/2	10
42"x29" to 49"x33"	.164"	2-2/3 x 1/2	8
57"x38" to 71"x47"	.164"	2-2/3 x 1/2	8
57"x38" to 71"x47"	.105"	3 x 1	12
71"x47" to 77"x52"	.105"	3 x 1	12
81"x58"	.135"	3 x 1	10

3) Joints.

Joints shall be made utilizing one piece connecting bands with at least 6 inches of rubber, neoprene or mastic gaskets. The connecting bands shall be 0.060 inch thick and fastened with at least 4 bolts. Width of bands shall conform to the following schedule.

a) Circular Pipe.

<u>Pipe Diameter</u>	<u>Band Width</u>
15" to 18"	12"
24"	12"
30" to 36"	15"
42" to 60"	18"

b) Pipe Arch.

<u>Span Rise</u>	<u>Band Width</u>
17"x13"	12"
21"x15" to 24"x18"	12"
28"x20"	12"
35"x24"	15"
42"x29" to 49"x33"	15"
57"x38" to 71"x47"	18"

5. DRAINAGE STRUCTURES:

Drainage structures shall be of the following types, constructed of the materials specified for each type and in accordance with the indicated details.

a) Manholes and Inlets.

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete or precast concrete segmental blocks, complete with frames and covers or gratings. Precast concrete manholes and inlets shall be designed for the required depth and to sustain the required wheel

loads and/or surface pressures. When manholes and inlets are to be constructed of prefabricated materials, shop drawings shall be submitted for approval before ordering the material.

b) Connection to Existing Inlets and/or Manholes.

Pipe connections to existing inlets and/or manholes shall be in such a manner that the finished work will conform as nearly as practicable to the applicable requirements specified for new inlets and/or manholes, including all necessary concrete work, cutting and shaping.

6. MATERIALS FOR DRAINAGE STRUCTURES:

a) Mortar.

Mortar for connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except the maximum placement time shall be one half hour.

Hydrated lime may be added to the mixture of sand and cement in a quantity equal to 25 percent of the volume of cement used. Hydrated lime shall conform to F.S. SS-L-351, Type M, or ASTM C141, Type A.

The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 5 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

b) Concrete.

Refer to Division 3.

c) Precast Reinforced Concrete Manholes.

Manholes shall conform to ASTM C478 or AASHTO M199. Joints between precast concrete risers and tops shall be flexible plastic gasket and shall provide a flexible watertight joint. Flexible plastic gasket shall be RAM-NEK or equal.

d) Precast Concrete Segmental Blocks.

Blocks shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

e) Bricks.

Bricks shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 3/4 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

f) Frame and Cover or Gratings.

Fabrication shall be from one or more of the material options presented in F.S. RR-F-621, except the malleable cast iron option shall conform to ASTM A220, Grade 40010. Weight, shape, size and waterway openings for grates and curb inlets shall be as indicated on the plans. Frames and covers for curb inlets and for areas not subject to vehicular traffic or storage may be malleable iron if so indicated. Malleable iron frames and covers shall conform to ASTM A220 and shall be of the weight, shape and size indicated.

7. BEDDING:

See Section 312002 "Excavation, Trenching and Backfill for Utility Systems," for additional requirements.

8. PLACING PIPE:

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipe lines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Pipe shall be moved horizontally into place by use of a winch or other suitable means. A backhoe bucket or other means which could damage the pipe shall not be used. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those damaged during placement shall be removed and replaced at no additional cost to the Owner. No additional compensation will be given to the Contractor for the required diversion of drainage and/or dewatering of trenches.

9. BACKFILLING:

Backfilling shall be done in accordance with Section 312002, "Excavation, Trenching and Backfill for Utility Systems."

10. BAG RIPRAP:

a) Materials.

Bag riprap shall consist of sand and Portland cement mixed at the ratio of 4:1 by weight. The amount of water used shall be sufficient to make up the optimum moisture content of the aggregate and cement, as determined by AASHTO T134.

b) Placement.

The bags shall be uniformly filled to the maximum capacity which will permit satisfactory tying. The bagged riprap shall be placed by hand with the tied ends facing the same direction, with close, broken joints. After placing, the bags shall be rammed or placed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than 3 inches above the required plan.

11. STONE RIPRAP:

a) Materials.

The stone used for stone slope protection shall be sound, rough, dense and resistant to the action of air and water and satisfactory to the Engineer. The stone shall have a density of not less than 150 pounds per cubic foot. Neither the breadth nor the thickness of any piece of stone shall be less than one-third of its length. The stone will be subject to inspection on delivery and if found to be improper

gradation or quality, it will be rejected. The stone shall consist of quarry run sizes, graded as specified below:

STONE SLOPE PROTECTION

SIZE OF STONE	PERCENT OF TOTAL WEIGHT SMALLER THAN THE GIVEN SIZE
------------------	--

Class I

100 lb.	100
60 lb.	80
25 lb.	50
2 lb.	Not to Exceed 10

b) Placement.

The slope protection shall be placed in such a manner as to produce a reasonable well-graded mass of material with the minimum practicable percentage of voids, and shall be constructed within the limits and to the lines, grades, and sections shown on the Plans. A tolerance of plus 6 inches or minus 3 inches from the limits shown on the Plans will be allowed in the finished surface on the slope protection except that the extreme of this tolerance shall not be continuous over an area greater than 100 square feet. Filter fabric (Mirafi 700X or approved equal) shall be placed and toed-in before placing riprap. Materials shall be placed in horizontal layers starting on the lower edge of the section and worked up the slope. Dumping down the slope will not be permitted. Materials shall not be dropped from a height greater than 3 feet. Any damage to the slope due to the fault of the Contractor shall be repaired at no expense to the Owner.

12. SUBGRADE DRAINS:

Subgrade drains will be provided from storm drain inlets where required because of the groundwater table. **It shall be the Contractor's responsibility to notify the Owner or the Engineer when evidence of groundwater conditions are observed so a recommendation for the extension of subgrade drains can be considered.** The subgrade drain will consist of a trench containing a 6 inch perforated pipe filled with granular material as shown in the detail on the Plans. The drain will extend 10 feet in two directions from the inlet and will be extended beyond that point when instructed. The drains will be constructed on a uniform slope toward the inlet. Cost for the first 10 feet in each direction will be included in the cost of the inlet with additional length paid on the basis of the unit price in the Bid Schedule.

13. SHOP DRAWINGS:

Shop drawings shall be submitted on each manufactured item supplied under this Section along with other information as specified.

END OF SECTION 334000

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**COLLEGE OF COASTAL GEORGIA
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**BRUNSWICK-GLYNN COUNTY WATER & SEWER
DESIGN AND CONSTRUCTION STANDARDS
PERMIT SUBMITTAL
APRIL 2024**

HUSSEY GAY BELL

Established 1958

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STANDARDS FOR WATER AND SEWER DESIGN AND CONSTRUCTION

February 2012



Planning and Construction Division
700 Gloucester Street, Suite 300, Brunswick, Georgia 31520

The Brunswick – Glynn County Joint Water and Sewer Commission expresses its sincere appreciation and gratitude to those local developers, utility contractors, consulting engineers and Georgia EPD Officials who contributed to the development of these standards.

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SECTION 1
GENERAL INFORMATION

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SECTION 1 GENERAL INFORMATION

1.1 INTRODUCTION

The Planning and Construction Division is the department within the Joint Water and Sewer Commission (**JWSC**) responsible for assisting in the planning, design, construction and acceptance of developer installed water and sewer utility systems as public infrastructure. The purpose of this document is to define the minimum requirements for the design and construction of such systems. The following documents form a part of these design and construction standards and are incorporated herein by reference:

Joint Water and Sewer Commission, Water and Sewer Ordinances, City of Brunswick

Joint Water and Sewer Commission, Water and Sewer Ordinances, Glynn County

Joint Water and Sewer Commission, Water and Wastewater Systems, Development Procedures

Joint Water and Sewer Commission, Record Drawing (As-Built) Standards.

Some JWSC Capital Improvement Projects (CIP's) and system rehabilitation projects may be designed and constructed in-house or by outside Engineers and Utility Contractors under contract to the JWSC. Such projects shall also conform to the requirements of these Design and Construction Standards and Specifications.

1.2 DEFINITIONS

Unless specifically stated otherwise, the meaning of the words and phrases used herein shall be as follows:

Joint Water and Sewer Commission: A body corporate and politic, a political subdivision of the State of Georgia and a public corporation created by an act of the General Assembly (Ga. L. 2006, p. 3661) acting by and through its commissioners, and responsible for the operations of the Utility.

City: The City of Brunswick, a municipal corporation, created and existing under the laws of the State of Georgia, acting by and through its Mayor and Commissioners.

County: Glynn County, a political subdivision of the State of Georgia, acting by and through its Board of Commissioners.

Developer/Owner: Any person or legal entity undertaking development.

Environmental Protection Division (EPD): The Environmental Protection Division, Department of Natural Resources, State of Georgia.

Infiltration/Inflow: Groundwater or surface water which leaks or otherwise enters into sanitary sewers through defective pipes, joints, manholes, yard drains, down spouts, sump pumps, or by other means or openings.

Planning and Construction Division: The department within the Joint Water and Sewer Commission (**JWSC**) responsible for assisting in the planning, design, construction and acceptance of developer installed water and sewer utility systems as public infrastructure.

Residential Equivalent Unit (REU): That portion of a user's facility that has an impact on the water and/or wastewater systems equivalent to a single family unit.

Satellite System: A private and independently owned water and/or wastewater system, including infrastructure, appurtenances, structures, lift stations, and devices, which connect to the Utility's public water and/or wastewater systems.

Specials: Non standard fitting.

Utility: The combined or unified water and wastewater systems of the City and County and any additions and extensions thereto, owned and operated by the Joint Water and Sewer Commission, acting by and through its commissioners.

Virgin: Not recycled.

Wall Castings: A component of ductile iron piping systems specifically designed and fabricated to be imbedded in poured-in-place concrete structures.

1.3 ABBREVIATIONS

The following abbreviations shall have the designated meanings:

AADF	Annual Average Daily Flow (Water Demand)
AASHTO	American Association of State Highway and Transportation Officials
ADWF	Daily Average Dry Weather Flow (Wastewater Demand)
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
AWWA	American Water Works Association
DIP	Ductile Iron Pipe
EPD	Georgia Environmental Protection Division
FPS	Feet per second
FPVC	Fusible Polyvinyl Chloride
GDOT	Georgia Department of Transportation
GPD	Gallons per Day
GPM	Gallons per Minute
HDPE	High Density Polyethylene
IAPMO	International Association of Plumbing and Mechanical Officials
JWSC	Joint Water & Sewer Commission
MDF	Maximum Daily Flow (Water Demand)
MGD	Million Gallons per Day
MIG	Metal Inert Gas
NEMA	National Equipment Manufacturing Association
NPT	National Pipe Thread
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PE	Polyethylene
PF	Peak Flow (Wastewater Demand)
PHF	Peak Hourly Flow (Water Demand)
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
REU	Residential Equivalent Unit
RMS	Root Mean Square
RPZ	Reduced pressure zone
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
VFD	Variable Frequency Drive
WPCF	Water Pollution Control Federation

1.4 PRELIMINARY INFORMATION REQUESTS

Upon request, the JWSC Planning and Construction Division will respond to questions regarding the availability of water and sewer service at a particular location. Such requests should be made in writing and include detailed information as to the size and location of the parcel to be served. Such information includes but is not limited to street address, Parcel ID Number, Owner's name, existing and proposed land use. A request form may be found on the JWSC website (<http://bgjwsc.org>) by clicking on the "Forms and Applications" tab.

Existing utility locations provided by the Planning and Construction Division shall be based upon the best available information from JWSC files such as GIS maps, record drawings, etc. No warranty is made by the JWSC, expressed or implied, as to the completeness or accuracy of such information.

Use of this information for planning and design purposes without proper field verification, shall be at the user's own risk.

For new and existing developments requesting water and sewer service, the JWSC reserves the right, to specify the point of service, the size and type of service, and the general layout of the overall system consistent with the standards and guidelines presented herein.

1.5 DEDICATION OF EXISTING PRIVATELY OWNED UTILITY SYSTEMS

Typically the JWSC does not accept privately owned utility systems for dedication as public infrastructure. This includes but is not limited to private on-site water distribution systems, private on-site gravity sewer systems, and private wastewater pumping stations and force mains.

The JWSC Board of Commissioners, at its discretion, may consider exceptions to this policy provided that one or more of the following criteria are met.

- a. Ownership of the system must be consistent with our service delivery strategy such that ownership of the system is necessary to extend water and sewer services to other potential customers.
- b. JWSC's system reliability or capacity may be improved or increased as a result of the dedication.
- c. Dedication of the system is warranted to eliminate or prevent potential environmental damage.

If accepted for ownership and maintenance the system must meet current design and construction standards of the JWSC or the standards of the City of Brunswick or Glynn County at the time of installation and the system must be functioning properly. The Planning and Construction Division will assist the utility owner in the identification of items of non-compliance with current standards. However the burden of proof of compliance remains with the utility owner. To this end, the following events shall occur:

- d. For water distribution systems, verification of the location, size, and materials of construction for all pipes, valves, hydrants, services, meters and other appurtenances will be required. Any components which are found to be defective or not in compliance with current standards and specifications must be relocated, repaired and/or replaced all at the expense of the existing utility owner. Adequate clearance must be maintained between all water lines and structures to allow future operation, maintenance and repairs to be conducted without endangering the structural integrity of any existing dwelling or structure.
- e. For the wastewater collection and transmission systems, verification of the location, size, and materials of construction for all gravity sewer pipes, manholes, service laterals and other appurtenances will be required. Pipe slopes must be verified to ensure adequate scouring velocity in the mains. Any components which are found to be defective or not in compliance with current standards and specifications must be relocated, repaired and/or replaced all at the expense of the existing utility owner. Adequate clearance must be maintained between all sewer lines and structures to allow future operation, maintenance and repairs to be conducted without endangering the structural integrity of any existing dwelling or structure.
- f. The existing utility owner shall engage the services of a registered land surveyor to prepare and submit record drawings of the water and sewer infrastructure in accordance with the JWSC Record Drawing (As-Built) Standards.
- g. Upon receipt of the preliminary record drawings, the JWSC will begin the confirmation process as outlined in the JWSC Development Procedures. This involves televising the wastewater collection system to determine system integrity and to confirm the slopes and location of manholes, mains, services, and service line cleanouts/stub-outs at properties to be served. During this process a list of wastewater system defects, issues of non-compliance with standards and/or drawing errors and omissions that require correction and re-verification prior to submission of the record drawings for final inspection may be developed by the JWSC staff.

- h. After the correction of any such defects or issues of non-compliance and verification of same by the JWSC, final record drawings with all applicable signatures and certifications shall be submitted and a final inspection of the water and wastewater systems shall be conducted. Upon the completion of the final inspection, the water and wastewater systems are determined either compliant or non-compliant. If compliant, the JWSC operational superintendents and project inspector endorse a JWSC statement on the record drawing to that effect. If non-compliant the process reverts to item (g.) above until all issues have been resolved.

Once the Record Drawings have been approved as compliant with applicable standards, the existing utility owner shall submit to the JWSC Executive Director the following as applicable:

- i. Water/Wastewater Systems Dedication Application
- j. Proposed easements, to include metes and bounds description of the property to be dedicated
- k. A survey in recordable form signed and sealed by a duly licensed surveyor depicting the metes and bounds description stated above

Upon review and approval of the proposed easement documents by the JWSC legal counsel, the Executive Director places the acceptance of the dedication on the next regular meeting of the JWSC Board of Commissioners for acceptance.

1.6 PLAN SUBMITTAL REQUIREMENTS (NEW CONSTRUCTION)

After review and approval of the conceptual water and wastewater system drawings in accordance with the *Joint Water and Sewer Commission, Water and Wastewater Systems, Development Procedures*, one (1) complete set of detailed construction plans shall be prepared and submitted to the JWSC . The detailed construction plans shall be prepared on 24"x36" sheets and shall be signed and sealed by a professional engineer registered in the State of Georgia.

The construction plan submittal shall include the following information as a minimum:

- a. An overall water and sewer master plan with proposed phases clearly indicated
- b. A north arrow and graphic scale on all plan sheets
- c. Vicinity map
- d. Lot numbers and street names
- e. Permanent or temporary benchmark
- f. Horizontal datum to be based on the Georgia State Plan, East Zone, and NAD83 with sub-meter accuracy
- g. Vertical datum to be based on NAVD88
- h. Owner/Developer contact information including name, address, phone and fax numbers, e-mail address, etc.

- i. Engineer's contact information including name, address, phone and fax numbers, e-mail address, etc.
- j. Ownership of the proposed systems shall be clearly designated as "Private" or "JWSC". See *Joint Water and Sewer Commission, Water and Wastewater Systems, Development Procedures* for additional information.
- k. Plan sheets for proposed water and sewer facilities drawn at a maximum scale of 1"=50' (Exception: If requested and approved by the JWSC, certain projects may be drawn using up to 1"=100' scale provided that the information shown is legible.)
- l. All facilities shall be clearly shown and labeled on the plan sheets including pipes, valves, fire hydrants, water services, sewer services, pumping stations and manholes (information to be shown includes but is not limited to size, station numbers, material of construction, slopes, appurtenances, etc.)
- m. Plan sheets shall have all existing and proposed easements clearly marked with size and location.
- n. Plan and profile sheets for proposed gravity sewers and forcemains drawn at a maximum scale of 1"=50' horizontal and 1"=5' vertical.
- o. Plan and profile sheets shall include station numbers, pipe size, length, materials, slopes, manhole top and invert elevations. Profile sheets shall show both existing and proposed grades, storm drain crossings, water main crossings and other utility crossings as appropriate. Forcemain elevations shall be shown every 100' and at all grade changes.
- p. Roadway cross sections with proposed utility locations depicted
- q. Miscellaneous construction details in accordance with Appendix 2B; Appendix 3B and Appendix 4B of these Standards and Specifications
- r. The following notes must appear on all construction plan submittals:

All water and sewer construction shall conform with the requirements of the Design and Construction Standards and Specifications of the Joint Water & Sewer Commission. In the event of a discrepancy between these construction plans and the aforementioned standards and specifications, the Design and Construction Standards and Specifications shall take precedence unless the deviation has been approved in writing by the JWSC.

The minimum horizontal and vertical separation between water lines, sewer lines and storm drains shall conform to the latest Georgia EPD requirements.

A minimum distance of 20' or two times the depth of the main, whichever is greater, shall be maintained from all buildings, foundations and the top of bank of all ponds. Any deviation from this requirement must be approved in writing by the JWSC.

Pressure and leakage testing shall be performed in accordance with the Design and Construction Standards and Specifications of the JWSC.

Disinfection of water mains shall be performed in accordance with the Design and Construction Standards and Specifications of the JWSC.

At least 72 hours prior to commencement of the work, the contractor shall notify the Utilities Protection Center (UPC) at 1-800-282-7411 to request underground utility locate service.

In the event that a construction plan submittal is deemed "Non-Compliant" after JWSC review, the plans shall be revised and one (1) set resubmitted until the plans are deemed "Compliant". Construction plans which have been revised and submitted for final review and approval shall have the revisions listed in the revision block on all affected sheets and the revisions shall be clearly marked (clouded) to highlight the changes.

The JWSC requires and keeps three (3) sets of design plans that have been signed, sealed and submitted on 24"x36" sheets with all plan review comments addressed. In addition, one (1) set of approved plans must be kept at the jobsite at all times. The Design Engineer is encouraged to submit, prior to the pre-construction conference, a sufficient number of plans in order to meet JWSC and the Developer/Owner's needs.

Any changes to the project which are made after final plan approval and that materially affect the system design shall require, additional plan submission, review and approval. JWSC approval shall be valid for a period of one year. If construction has not commenced within one year, a re-submittal is required.

1.7 PROTECTION OF EXISTING UTILITIES

The protection of existing utilities shall be solely the responsibility of the contractor. The location and size of existing utilities, if any, shown on the construction plans may not be complete or accurate as to horizontal or vertical location. The existence of buried or overhead utilities not shown shall not relieve the contractor of his responsibilities under this requirement. The contractor shall excavate and visually, verify the existence, size and location of all existing utilities. ***At least 72 hours prior to commencement of the work, the contractor shall notify the Utilities Protection Center (UPC) at 1-800-282-7411 to request underground utility locate service.*** The contractor shall indemnify and hold harmless the JWSC, their officers, agents and employees from any claims or actions for damage to any existing utility or any liability which may arise there from.

1.8 PERMITTING

Glynn County R/W Permit

All work on City of Brunswick or Glynn County Rights-of-Way requires a permit from the appropriate Public Works Department. The Contractor is solely responsible for obtaining such permits and paying all required fees prior to commencement of the work.

GDOT Utility Encroachment Permit

All utility construction on the Georgia Department of Transportation (GDOT) Rights-of-Way requires a utility encroachment permit. The JWSC will obtain such permits. Certain information is required from the Developer/Contractor/Engineer before such applications are filed. Contact the JWSC for additional information.

The Contractor will be given a copy of the GDOT permit. The contractor shall perform all work within the GDOT right-of way in accordance with all applicable requirements of the permitting agency.

Railroad Crossing Permits

All utility construction on the CSX, Norfolk Southern and Colonel's Island Railroads rights-of-way require a utility encroachment permit from the appropriate agency if their respective form of ownership (easement, fee simple etc.) gives them the right to require same. Unless otherwise noted, the Developer/Contractor/Engineer shall obtain the utility encroachment permit from the appropriate agency and pay all required fees. The contractor shall perform all work within the railroad right-of way in accordance with all applicable requirements of the permitting agency.

NPDES Permit

Unless otherwise noted, the Developer/Contractor/Engineer shall prepare and file the Notice of Intent for Coverage under the applicable NPDES General Permit to Discharge Storm Water Associated with Construction Activity and pay all required fees. The Contractor shall be responsible for implementation of the Erosion, Sedimentation and Pollution Control Plan, including rainfall monitoring, inspections and all other requirements of the permit.

Land Disturbing Activity Permit (LDA)

If required and unless otherwise noted, the Developer/Contractor/Engineer shall obtain the Land Disturbing Activity Permit and pay all required fees. The contractor shall be responsible for implementing all requirements of said permit.

1.9 SURFACE RESTORATION

All disturbed areas shall be re-vegetated immediately after construction in a manner consistent with the *Manual for Erosion and Sediment Control in Georgia*. All erosion and sediment controls shall be installed prior to or concurrent with the start of construction.

Any reference points, right-of-way monuments, property corners, benchmarks or other monuments disturbed as a result of construction shall be restored by a Registered Land Surveyor licensed to practice in the State of Georgia, with all associated costs borne by the contractor. Likewise all landscaping, street signs, mailboxes, traffic signs and other street furniture disturbed by construction operations shall be restored by the contractor to their original condition without additional compensation.

Existing pavements shall be removed to clean straight lines by saw cutting. See the standard construction details for additional information.

1.10 REFERENCE POINTS AND LAYOUT

The contractor shall be responsible for all construction lay-out and staking including setting of grades, lines and levels; and the location of existing and proposed easements and/or rights-of way. The contractor's surveyor shall provide centerline alignment for construction purposes and establish and maintain benchmarks and horizontal control points. The contractor shall assume all responsibility for the correctness of the grade and alignment stakes.

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WATER DISTRIBUTION SYSTEMS

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SECTION 2 WATER DISTRIBUTION SYSTEMS

2.1 GENERAL

This section provides the minimum guidelines for the design and construction of water transmission and distribution systems. The method of design and/or construction shall be in accordance with these Design and Construction Standards and Specifications and the following:

Georgia Rules for Safe Drinking Water Chapter 391-3-5 promulgated under the Georgia Safe Drinking Water Act

Georgia Environmental Protection Division Minimum Standards for Public Water Systems, Latest Edition

American Water Works Association (AWWA)

Applicable Federal, State and Local Requirements

In the event of conflicts among the various sources cited above, the most stringent criteria shall take precedence.

2.2 DESIGN FLOWS

Each water system component shall be designed to meet certain flow requirements to ensure that water will be available in adequate quantities to meet demand characteristics throughout the system. The various flow requirements are described below.

2.2.1 Annual Average Daily Flow (AADF)

The average daily demand expresses the average amount of water used in a system during an average day. One Residential Equivalent Unit (REU) is the equivalent demand that can be expected for one residential connection. The AADF shall be 300 gallons per day per REU. In as much as the AADF will often be exceeded, it is generally not appropriate to use AADF for design purposes.

2.2.2 Maximum Daily Flow (MDF)

The maximum daily demand expresses the maximum amount of water used in a system in one day during peak demand. Normally expressed in gallons per day, the MDF is normally used in the design of water production and storage facilities. For water systems located in the City District, North Mainland District and South Mainland District of Glynn County, the estimated MDF shall be calculated as 1.54 times the AADF. For water systems located on St. Simons Island the MDF shall be calculated as 1.40 times the AADF.

2.2.3 Peak Hourly Flow (PHF)

The peak hourly demand expresses the maximum amount of water used in any hour during a day. Normally expressed in gallons per minute, PHF is used, in conjunction with fire flow requirements, in the design of water distribution systems. For water systems located in the City District, North Mainland District and South Mainland District of Glynn County, the estimated PHF shall be calculated as 2.2 times the AADF. For water systems located in on St. Simons Island, the estimated PHF shall be calculated as 2.0 times the AADF.

2.2.4 Fire Flow Requirements

A minimum fire flow of 500 gallons per minute with a residual pressure of 20 PSI for 2 hours at the fire hydrant shall be required.

2.3 SIZING OF WATER MAINS

Water distribution systems must be designed to maintain a residual pressure of at least 20 PSI at each service connection and at all points in the distribution system under all conditions of flow, including fire flow. All construction plan submittals shall be accompanied by a hydraulic analysis prepared by a Professional Engineer registered in the State of Georgia, demonstrating compliance with these design and construction standards and specifications. The hydraulic analysis shall clearly state the basis for the design flows.

2.3.1 Major Transmission Mains

The size of major transmission mains or extensions to such mains, throughout the system shall be in accordance with JWSC Water and Sewer Master Plan, latest revision. Contact the JWSC for additional information and guidance with regard to this requirement.

2.3.2 Distribution Mains

The minimum water main size in residential subdivisions to which fire hydrants are connected shall be eight (8) inches in diameter. It is preferred that such subdivisions be designed with two feeds from a distribution main external to the project wherever possible. In cases where two feeds are not practical, the size of the single main extension serving the development or looped grid must be verified in the hydraulic analysis.

Distribution mains smaller than eight (8) inches in diameter will be considered on a case by case basis, but in no case shall distribution mains smaller than two (2) inch be used. No more than five (5) REU's may be served by a single two (2) inch main.

2.3.3 Velocities in Water Mains

The hydraulic analysis must demonstrate that expected velocities in new distribution mains do not exceed five (5) feet per second at the PHF.

2.3.4 Hazen Williams Roughness Coefficients

The hydraulic analysis shall use roughness coefficients (C-factors) in the Hazen-Williams formula in accordance with the following:

Pipe	C-factor
Ductile iron pipe (sixteen (16) inches in diameter and above)	120
Ductile iron pipe (Less than sixteen (16) inches in diameter)	130
PVC pipe (All sizes)	140
HDPE pipe (All sizes)	140

2.4 MATERIAL SPECIFICATIONS

The contractor shall furnish potable water piping systems in accordance with the material specifications detailed below. All references to industry standards (ASTM, ANSI, AWWA, etc.) shall be to the latest revision unless stated otherwise. All materials shall be new. These material specifications include a list of acceptable manufacturers for the various water system components (See Appendix 2A). The contractor may choose freely from the manufacturers list and **material submittals for such items are not required**. Only products and materials from the acceptable manufacturer's lists herein may be used in the work. Any item required but not specified herein, or any product or manufacturer other than those listed will be considered a substitution. **Material submittals are required for such items**. Substitutions will not be allowed without the prior written approval of the JWSC. Substitutions, if allowed, shall meet all criteria of the detailed specifications.

The burden of proof for compliance of any proposed substitution rests with the Contractor/Developer/Owner. The JWSC will be the sole judge as to the acceptance of a proposed substitution and such decisions will be final.

2.4.1 Potable Water Pipe

Pipe for potable water lines shall be ductile iron, polyvinyl chloride (PVC), polyethylene tubing or high density polyethylene (HDPE). Pipe sizes and applications shall conform to the following table.

**Figure WD-1
Pipe Size and Application Table**

PIPE	PIPE SIZE	JOINT TYPE	APPLICATION
Ductile Iron	4" diameter and larger	Mech. Joint Push-on Joint Flanged Joint*	Water Mains Above Ground Below Ground
PVC DR 14 PVC DR 18 PVC DR 25	4" diameter and larger	Push-on Joint	Water Mains Below Ground
PVC SDR 21	2" diameter	Push-on Joint	Water Mains Below Ground
Polyethylene Tubing	2" diameter and smaller	(See Below)	Water Services
HDPE	2" diameter and larger	Fused	Water Mains Water Services Below Ground
Steel	4" diameter and larger	Welded	Casings Only

* Flanged joints for above ground applications only

2.4.1.1 Ductile Iron Pipe

Ductile iron pipe wall thicknesses and pressure class shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151) with pressure class 150 as a minimum. Each length shall be clearly marked with the name of the manufacturer, pressure rating, thickness or pressure class and nominal pipe diameter.

All ductile iron pipe shall be externally coated with a bituminous coating per ANSI A21.51. In areas of corrosive soils as defined in AWWA C105, Appendix A, all bolts, nuts, studs and other uncoated parts of joints for underground installations shall be coated with asphalt or coal tar prior to backfilling.

The interior of all ductile iron pipe, fittings and specials shall be cement lined with a seal coat. The lining shall comply with ANSI A21.4 (AWWA C104). In areas of severely aggressive soils, provide polyethylene encasement for all ductile iron piping systems in accordance with AWWA C105.

2.4.1.2 Polyvinyl Chloride (PVC) Pipe

Pipe shall be virgin polyvinyl chloride (PVC) pipe for potable water and shall have a bell type coupling with a thickened wall section integral with the pipe barrel in accordance with ASTM D3139. Provisions must be made for expansion and contraction at each joint with flexible ring gaskets made of rubber or other suitable material. Elastomeric seals shall meet ASTM F477.

PVC water pipe four (4) inches through twelve (12) inches in diameter shall conform to AWWA C900 Pressure Class (PC) 235 DR-18. PVC water pipe fourteen (14) inches and larger shall conform to AWWA C905 Pressure Class (PC) 235 DR-18. Pipe is to be manufactured to ductile iron pipe equivalent outside diameters. Pipe for water mains shall be blue in color with each length marked with name of the manufacturer, pressure rating, nominal pipe diameter and the seal of the National Sanitation Foundation (NSF).

PVC water pipe two (2) inches in diameter and smaller shall conform to ASTM D2241, Pressure Rating (PR) 200 SDR-21 with push-on type jointing. Glued or Solvent weld joints shall not be used. Pipe for water mains shall be blue in color (preferred) with each length marked with name of the manufacturer, pressure rating, nominal pipe diameter and the seal of the National Sanitation Foundation (NSF). If blue is not available, white may be used.

2.4.1.3 Polyethylene Tubing

All water services two (2) inches in diameter and smaller shall be manufactured of PE 3408, high density polyethylene in accordance with AWWA C901, ASTM D1248, ASTM D2239, ASTM D2737 and ASTM D3350. Tubing shall have a minimum working pressure of 200 PSI, shall be copper tube size SDR-9 and shall be blue in color. Couplings shall be made of bronze with compression fittings on both ends suitable for connection to polyethylene tubing with inserts.

Tubing shall be approved for use with potable water by the National Sanitation Foundation and shall be continuously marked at intervals of not more than four (4) feet with the nominal size, pressure rating, NSF seal, manufacturer's name, standard dimension ratio and ASTM specification.

2.4.1.4 High Density Polyethylene (HDPE) Pipe

Materials used for the manufacturing of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345464C per ASTM D3350; and meeting Type III, Class B or Class C, Category 5, Grade P34 per ASTM D1248.

HDPE pipe four (4) inches in diameter and larger shall conform to AWWA C906, DR-11, ductile iron pipe size and NSF 61 Standard. HDPE pipe shall be manufactured in accordance with ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-PR) based on Controlled Outside Diameter and shall be so marked. Pipe sizes are nominal and may require up-sizing so that the inside pipe diameter is approximately the same as the PVC pipe diameter where applicable. HDPE pipe used for potable water shall be permanently identified by multiple co-extruded blue color stripes equally spaced into the outside surface of the pipe.

Electro fusion branch saddles for wet tap applications shall meet AWWA C906 and be designed and manufactured in accordance with ASTM F1055 for use with HDPE pipe. Outlets shall be in accordance with ASTM D3261 specifically manufactured for HDPE pipe.

Polyethylene flange adaptors shall be made with sufficient through bore length to be clamped in a butt fusion joining machine without the use of a stub end holder. The sealing surface of the flange adaptor shall be machined with a series of small v-shaped grooves to provide gasket-less sealing or to restrain the gasket against blow out. Flange adaptors shall be fitted with convoluted type ductile iron back up rings meeting ASTM A536, Grade 65/45/12. Flange bolts and nuts shall be grade 2 or higher.

Polyethylene mechanical joint adaptors used for connections of HDPE pipe to ductile iron or PVC piping, mechanical joint fittings or valves shall be self restraining, fusible mechanical joint adaptors and shall be of the same SDR rating as the pipe. Adaptors shall include longer T-bolts or all thread rods with nuts at the mechanical joint bell.

2.4.1.5 Steel Casing Pipe

Steel casing pipe shall conform to either ASTM A139 for *Electric Fusion (arc) Welded Steel Pipe* with a minimum yield strength of 35,000 PSI or API-5LX, Grade X-42.

Wall thicknesses shall meet the requirements of the American Railway Engineering Association Manual of Recommended Practice or the Georgia (GDOT) Standard Specifications. For street or highway crossings which are not under railroad or GDOT jurisdiction, the GDOT standards shall be used. Pipe inside diameter shall be in accordance the JWSC standard water construction details. Pipe lengths shorter than eight (8) feet long may not be used unless approved by the JWSC.

2.4.2 Fittings

Fittings for PVC and ductile iron pipe 4-inches in diameter and larger shall be ductile iron with mechanical joints for below ground applications and flanged joints for above ground installations. Fittings for PVC piping two (2) inches in diameter and smaller shall be push-on bell type.

2.4.2.1 Ductile Iron Fittings

Ductile iron fittings shall conform to ANSI A21.10 (AWWA C110), ANSI A21.11 (AWWA C111), A21.15 (AWWA C115), and/or A21.53 (AWWA C153). **Compact fittings shall normally be used** but this does not preclude the use of standard or long body fittings where shown on the plans or at the direction of the JWSC. All ductile iron fittings shall be externally coated and internally lined as specified in paragraph 2.4.1.1 of this section.

Fittings shall have cast on them the pressure rating, nominal diameter, manufacturer's name, foundry location and type of fitting (degrees or fraction of a circle). Cast letters and figures shall be on the outside body of the fitting. Fittings shall have a minimum working pressure of 250 PSI.

2.4.2.2 PVC Fittings

PVC 1120, SDR-21 fittings shall be injection molded, push-on bell type with elastomeric rubber seals in accordance with ASTM D3139. Seals shall conform to ASTM F477.

2.4.2.3 Non-Standard Fittings and Wall Castings

The JWSC shall approve all fittings having non-standard dimensions and cast specifically for a particular project. Such fittings shall meet the requirements of the same standards listed in paragraph 2.4.2.1 and shall have the same diameter and thickness as standard fittings. Laying lengths and types of ends shall be determined by the particular application and the piping to which they connect.

Wall castings shall be as indicated on the drawings. Flanges shall be faced and drilled to 125-pound ANSI Standards. Flanges shall be tapped for studs.

2.4.3 Joints

The type of joints used for piping and fittings shall be in accordance with the following specifications. Joints shall be made in accordance with the manufacturer's printed instructions.

2.4.3.1 Mechanical Joints

Mechanical joint materials, assembly and bolting shall be in accordance with ANSI A21.11 (AWWA C11). All glands shall be epoxy coated ductile iron.

2.4.3.2 Flanged Joints

Flanged joints for ductile iron piping shall conform to ANSI A21.10 (AWWA C110), and ANSI A21.15 (AWWA C115). Flanges shall be in accordance with ANSI B16.1, Class 125. Gaskets shall be used on all flanges. Gaskets shall be rubber ring type with cloth inserts and a minimum thickness of one eighth (1/8) inches. Bolts and nuts shall be Grade B conforming to ASTM A307. The number and size of bolts shall be in accordance with the same ANSI Standard as the flanges.

2.4.3.3 Restrained Joints

On ductile iron fittings, mechanical joint restraints shall be incorporated into the design of the follower gland. Restraint devices shall consist of multiple gripping wedges incorporated into the follower gland and meeting the requirements of ANSI A21.10 (AWWA C110). Gland body, wedges and wedge actuating components shall be ductile iron in accordance with ASTM A536. Dimensions of the gland shall be such that it can be used with the standard mechanical joint bell and tee head bolts. Twist off nuts (same size as the tee head bolts) shall be used to ensure proper actuation of the restraining device. The mechanical joint restraint shall be designed to accommodate the full working pressure of the pipe with a minimum safety factor of 2.0.

Where called for on the plans, joints on ductile iron piping may be restrained by utilizing a joint restrained gasket which includes a stainless steel locking segment vulcanized into the rubber gasket. The gasket shall be rated for operating pressures up to 250 PSI in accordance with ANSI A21.11 (AWWA C111).

Where it is necessary to restrain PVC pipe bells adjacent to valves and fittings, a harness restraint device shall be used in lieu of thrust blocking. The restraint shall be manufactured of ductile iron in accordance with ASTM A536. A split ring shall be used behind the pipe bell with a serrated ring to grip the pipe. A sufficient number of steel tie rods/bolts shall be used to connect the bell ring and the gripping ring. The harness restraint device shall accommodate the full working pressure of the pipe with a minimum safety factor of 2.0.

The use of concrete thrust blocks as a method of joint restraint shall be limited to situations such as ties to or work associated with existing systems where exposing several joints of pipe is not feasible due to existing ground conditions. In such cases other restraining devices may be required at the direction of the JWSC. Concrete thrust blocks may be used in combination with tie rods in accordance with the JWSC standard construction details. Where used concrete shall be 2,500 PSI minimum.

Where tie rods are used as a method of restraint at mechanical joint fittings and valves, offset eyebolts shall be used to connect tie rods to the fitting. Tie rods shall be steel, threaded as required and installed with a washer and nut (same material as the rod) on either side of the joint. The size and number of tie rods shall be in accordance with the Figure WD-2.

**Figure WD-2
Tie Rod Size and Number Table**

Pipe Size	No. of Rods	Rod Size
4"	2	3/4"
6"	2	3/4"
8"	2	3/4"
10"	4	3/4"
12"	4	3/4"
14"	6	3/4"
16"	6	3/4"
>16"	*	*

* Contact JWSC

2.4.4 Water Valves and Appurtenances

Water valves shall be of the size and type shown on the approved construction plans. All valves shall open by turning left or "counter-clockwise". Extension stems on buried valves will be used only at the direction of the JWSC.

2.4.4.1 Gate Valves

Gate valves four (4) inches in diameter and larger shall be resilient seat wedge type conforming to applicable sections of AWWA C509 or C515 designed for a minimum working pressure of 250 PSI. When fully open, gate valves shall have a clear port equal to the nominal diameter of the pipe on which it is installed.

Buried gate valves shall be non-rising stem type, epoxy coated, iron body, bronze mounted with all exterior mounted bolts and nuts of 316 stainless steel. Buried gate valves shall have mechanical joint ends and be equipped with a two (2) inch square operating nut and adjustable valve boxes and covers. Valve boxes shall be as specified in paragraph 2.4.4.3 below.

Gate valves installed above ground may be hand wheel operated, non-rising stem type with flanged ends meeting the same general construction as buried valves. Hand wheels shall not be used inside structures or vaults.

Gate valves two (2) inches to three (3) inches in diameter shall be non-rising stem, resilient seat wedge type with epoxy coated iron body and two (2) inch square operating nut. Valve shall conform to the applicable requirements of AWWA C509 and ASTM A126 Class B with threaded ends and designed for 200 PSI working pressure.

2.4.4.2 Fire Hydrants

Fire hydrants shall be of the compression type, closing with line pressure, and conforming to AWWA C502. Fire hydrants shall have a minimum valve opening of five and one-fourth (5 ¼) inches with two and one-half (2 ½) inch hose nozzles and one four and one-half (4 ½) inch pumper nozzle. Hydrants shall open left or counterclockwise. The nozzle caps shall be securely chained to the hydrant barrel and be constructed of heavy duty corrosion resistant material.

Fire hydrants shall be fully bronze mounted. All nuts and bolts shall be 304 stainless steel. All working parts, including the valve seat ring, shall be removable through the top of the hydrant without disturbing the barrel. The operating threads shall be totally enclosed in an operating chamber separated from the hydrant barrel by a rubber o-ring stem seal and lubricated by a grease or oil reservoir. The hydrant operating nut shall be pentagon shaped (5-sided) measuring one and one-half (1 ½) inches from point to flat. The inlet connection shall be six (6) inch mechanical joint type.

Fire hydrants shall be traffic type such that the barrel will break away from the standpipe at a point above grade to prevent damage to the barrel and stem. Fire hydrants shall be of a non-freezing type design and shall be provided with a simple and positive automatic drain which will be fully closed whenever the main valve is opened.

The entire outside surfaces of the fire hydrant barrel above grade shall be factory primed and then painted with Koppers GLAMORTEX 501 red enamel paint. The base shoe shall be painted with a minimum 4 mils thick epoxy and the lower barrel shall be asphaltic or epoxy coated.

2.4.4.3 Valve Boxes

Valve boxes shall be cast iron, heavy duty roadway, screw type adjustable to six (6) inches up and down from the nominal required cover over the pipe. Six (6) inch PVC C900 Pipe shall be used to extend valve boxes to grade. Cast iron castings shall be manufactured of clean, even grain, gray cast iron conforming to ASTM A48, Class 20B. Valve boxes shall have cast iron drop covers with the word "WATER" stamped on it.

2.4.4.4 Tapping Valves and Sleeves

Tapping sleeves shall be used for live tap applications or where directed by the JWSC. Tapping sleeves shall be stainless steel wrap around type conforming to ASTM A126 and shall accommodate the full working pressure of the system.

Tapping valves shall meet the requirements of paragraph 2.4.4.1 of this section. Tapping valves shall be flanged on one end for connection to the tapping saddle and mechanical joint on the other end. MJ tapping saddles and valves shall be used where the main to be tapped is not level so that the valve operator may be installed in a vertical position.

2.4.5 Water Services and Appurtenances

2.4.5.1 Corporation Stops

Corporation stops are required on all water services. Corporation stops shall be made of brass conforming to AWWA C800, ASTM B62 and/or ASTM B584 and shall accommodate the full working pressure of the system. The inlet connection shall be AWWA standard iron pipe (IPT) thread. The outlet connection shall be compression type for polyethylene tubing.

2.4.5.2 Curb Stops

Curb stops shall be ball valve type conforming to AWWA C800. Curb stops shall be made of brass conforming to AWWA C800, ASTM B62 and/or ASTM B584 and shall accommodate the full working pressure of the system. Service line connections shall be compression type for polyethylene tubing.

2.4.5.3 Double Strapped Tapping Saddles

Double strapped tapping saddles shall be epoxy coated ductile iron body type with NPT service outlet. The saddles shall have a self energizing o-ring rubber gasket, two alloy steel straps, and a female iron pipe tap conforming to AWWA C800.

2.4.5.4 Meter Boxes (Residential)

Meter boxes for residential services shall be furnished and installed by the contractor/developer. Boxes shall be oval in shape, of cast iron construction with minimum dimensions of 20" L x 10¼" W x 9¾" D suitable for a one (1) inch meter set.

2.4.5.5 Meter Boxes (1 ½" to 2")

Meter boxes for one and one-half (1½) inch to two (2) inch meters shall be rectangle in shape. Boxes shall be constructed of a light weight plastic composite material with a minimum tensile strength of 3400 PSI. Dimensions shall be suitable for the meter installed.

2.4.6 Backflow Prevention Devices

2.4.6.1 Double Check Valve (DCV) Assemblies

The backflow preventer shall feature modular check assemblies with center stem guiding. Each check module shall have a captured spring and be accessible through a bolted cover plate. Seats shall be replaceable without special tools. The device shall be completely factory assembled and include, in addition to the check modules, tight closing resilient seated shut off valves, test cocks and strainer.

The assembly shall meet the requirements of USC Manual 8th Edition, ASSE No. 1015, AWWA C510, CSA B64.5, IAPMO PA31 and UL Classified File No. EX3185.

2.4.6.2 Reduced Pressure Zone (RPZ) Assemblies

The RPZ shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting.

The assembly shall meet the requirements of USC Manual 8th Edition, ASSE Std. 1013, AWWA C511, IAPMO File No. 1563 and CSA B64.4.

2.4.7 Miscellaneous Items

2.4.7.1 Detection Tape

Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. The tape shall be safety blue in color, shall be at least two and half (2-1/2) inches wide and will bear the printed identification "CAUTION: BURIED WATER LINE BELOW".

2.4.7.2 Tracer Wire

Water pipe tracer wire shall be AWG 12/1, single conductor solid copper with blue jacket, UL rated suitable for direct burial, temperature range -20° C to 60° C, 600 Volts RMS.

2.4.7.3 Casing Spacers

Casing spacers shall be a two piece shell per carrier pipe and made from T-304 stainless steel of a minimum 14 gauge thickness. Each shell section shall be lined with a 0.090" thick, ribbed PVC extrusion with a retaining section that overlaps the edges of the shell and prevents slippage. Bearing surfaces (runners) shall be ultra high molecular weight polyethylene to provide abrasion resistance and a low coefficient of friction. The runners shall be attached to support structures (risers) at appropriate positions to properly support the carrier pipe within the casing pipe. The runners shall be mechanically bolted to the riser. Risers shall be made of T-304 stainless steel of a minimum 10 gauge. All risers shall be MIG welded to the shell. Bottom risers six (6) inches and over in height shall be reinforced. All reinforcing plates shall be 10 gauge T-304 stainless steel and shall be MIG welded to mating parts. All nuts, bolts and washers shall be 304 stainless steel.

2.4.7.4 End Seals

Unless dictated otherwise by GDOT or railroad specifications, casing and seals shall be pull-over type made from neoprene with T-304 stainless steel bands for securing to the carrier and casing pipe.

2.5 INSTALLATION OF WATER MAINS AND APPURTENANCES

The contractor shall install potable water piping systems in accordance with the specifications detailed below. All references to industry standards (ASTM, ANSI, AWWA, etc.) shall be to the latest revision unless stated otherwise.

2.5.1 *Product Delivery, Handling and Storage*

The contractor shall inspect all materials delivered to the job site for damage. Materials shall be unloaded and stored with a minimum of handling. Materials shall be stored above ground and the interior of pipe and fittings shall be kept free of dirt and debris. Store non-metallic piping and rubber gaskets under cover and protect from exposure to sunlight.

Pipe, fittings, valves, hydrants and other appurtenances shall be handled to ensure delivery at the point of installation in sound, undamaged condition. If coating or linings of pipe or fittings are damaged, such pipe and fittings shall be removed from the site and new materials furnished. Pipe shall not be dragged.

2.5.2 *Excavation and Backfilling*

2.5.2.1 General Excavation

The contractor shall examine the work site and inform himself fully as to the nature of all materials to be encountered during excavation for the construction of the various facilities and related appurtenances. The contractor shall perform excavation of all substances encountered to the depth shown on the drawings. Trench width and/or depth shall be as shown on the ***JWSC Standard Details***.

Excavation shall not be carried below the required level. Where excavation is carried below the grade indicated through error, the contractor shall refill to the proper grade with AASHTO Class A-3 soil or granular backfill if directed by the JWSC Inspector and compact to obtain a suitable pipe support.

All excavation work shall be in accordance with OSHA safety standards, including OSHA Excavation Standards (29 CFR Subpart P 1926.650).

2.5.2.2 Dewatering

The contractor shall keep all excavations clear of water while pipe and appurtenances are being installed. All water pumped or bailed from trenches and other excavated areas shall be conveyed to a point of discharge where it will cause no hazard to the safety and protection of the public, to private property or to other work in progress.

2.5.2.3 Backfilling and Compaction

If unsuitable materials are encountered, such materials may not be used for backfilling operations and shall be removed from the site. Unsuitable material includes but is not limited to debris, muck, clay, large clods, stones, wood, stumps, and roots.

Generally piping and appurtenances shall be observed by the JWSC Inspector prior to backfilling. Should it be necessary to backfill trenches, prior to observation by JWSC inspector, pipe joints shall be left exposed for observation. Backfill and compaction shall be performed to achieve the densities specified below. Methods for the placement of backfill and compaction shall be subject to the approval of the JWSC.

For excavation under pavement, backfill shall be placed in uniform, six (6) inch compacted layers and compacted to 98% of its maximum density as determined by Laboratory Modified Proctor Test, ASTM D1557 to an elevation of one (1) foot above the top of the pipe. The remainder of the trench backfill shall be placed in twelve (12) inch compacted layers and compacted to 98% of its maximum density as determined by Laboratory Modified Proctor Test, ASTM D1557.

When excavating under existing pavement, such pavement shall be removed to clean straight lines by saw cutting. Backfill shall be placed in uniform, six (6) inch compacted layers and compacted to 98% of its maximum density as determined by ASTM D1557 to an elevation of one (1) foot above the top of the pipe.

The remainder of the trench backfill shall consist of graded aggregate to be placed in six (6) inch compacted layers and compacted to 98% of its maximum density as determined by ASTM D1557. The in-place density is to be tested by ASTM D2922 or ASTM D1556. See the **JWSC Standard Details** for additional information.

For excavation not under pavement, backfill shall be placed in uniform layers, six (6) inch compacted layers and compacted to 98% of its maximum density as determined by Laboratory Modified Proctor Test, ASTM D1557 to an elevation of one (1) foot above the top of the pipe. The remainder of the trench backfill shall be placed in twelve (12) inch compacted layers and compacted to 98% of its maximum density as determined by Laboratory Modified Proctor Test, ASTM D1557.

If deemed necessary by the JWSC, the contractor shall, at his expense, retain the services of an independent testing laboratory to make in place density tests of backfilled trenches to confirm compaction as specified herein.

2.5.3 Water Mains

2.5.3.1 Pipe Installation

All PVC C900/C905 pipe shall be laid in accordance with AWWA C605. All ductile iron pipe and fittings shall be laid in accordance with the manufacturer's recommendations and AWWA C600. Each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses excavated to accommodate bells and joints.

Excavation, cleaning, laying, jointing and backfilling shall follow as closely as possible during prosecution of the work. In no case shall pipe be left in the trench overnight without completing the jointing. All precautions shall be taken to prevent sand, dirt and debris from entering the pipe during installation. Any time that pipe installation is not in progress, open pipe ends shall be closed by a watertight plug or other method approved by the JWSC Inspector.

Plugs shall remain in pipe ends until all water has been removed from the trench and any foreign material that enters the pipe shall be removed immediately. No pipe shall be installed when trench or weather conditions are unsuitable for such work, as determined by JWSC.

2.5.3.2 Pipe Alignment

Pipe alignment and gradient shall be straight or shall follow true curves as near as practicable. Curvature in pipe lines, where required, shall be well within (no more than 80% of) the manufacturer's allowable joint deflection or laying radius for the pipe supplied. Otherwise fittings shall be required.

Water mains shall be installed in locations shown on the plans. New water mains in residential subdivisions shall generally be located five (5) feet behind the curb where curb and gutter is used. Where roadside ditches are used in lieu of curb and gutter, the water mains should be placed at the edge of the road shoulder no closer than four (4) feet from the edge of pavement. The placement of water lines, valves and hydrants within the ditch shall require the approval of the JWSC.

2.5.3.3 Pipe Cover

Pipe shall be laid with a minimum cover of forty two (42) inches in paved areas and thirty six (36) inches in unpaved areas with an allowable maximum of sixty (60) inches. Cover in all areas shall be measured from crown of pipe to finish grade. Reductions in pipe cover requirements require the approval of the JWSC. Cover requirements are shown on the **JWSC Standard Details**.

Greater depths are permissible when required to clear obstructions, conflicts, etc. The contractor shall contact the JWSC in advance for instructions as to the modifications necessary. A detail for utility conflicts is shown on the **JWSC Standard Details**.

2.5.3.4 Separation Requirements

Water lines shall not be laid closer than ten (10) feet horizontally from a sanitary sewer main or septic tank line. Exceptions require the approval of the JWSC Planning and Construction Division. Sanitary sewer lines shall pass beneath water lines with the top of the sewer being at least eighteen (18) inches below the bottom of the water line, where sewer lines cross water lines. No joints in the sewer line shall be located closer than ten (10) feet horizontal distance from the water line.

2.5.3.5 Thrust Restraints

All non-flanged fittings and valves shall be restrained. This shall be accomplished using mechanical restraints at fittings and mechanical restraint along adjacent joints of pipe in accordance with the **JWSC Standard Details**. Restraining devices and tie rods, where required, shall be in accordance with paragraph 2.4.3.3 above.

The use of concrete thrust blocks as a method of joint restraint shall be limited to situations such as point repair where exposing several joints of pipe is not feasible due to existing ground conditions. In such cases other restraining devices may be required at the direction of the JWSC. Concrete thrust blocks may be used in combination with tie rods in accordance with the JWSC standard construction details. Where used concrete shall be 2,500 PSI minimum.

All joints within steel casing pipe shall be restrained with mechanical restraining devices. Harness restraints on PVC (caps) pipe installed within casings may require larger casing pipes.

2.5.3.6 Tracer Wire and Detection Tape

Contractor shall furnish and install locate wiring on all non-metallic water mains in accordance with the **JWSC Standard Details**. Locate wire shall be brought to grade outside a valve box or locating station box, as required, at four hundred and seventy five (475) foot intervals (maximum). In addition, all water mains shall have detection tape installed two (2) feet above the pipe. Tracer wire and detection tape shall be as specified in paragraphs 2.4.7.1 and 2.4.7.2 above.

Installed locate wiring shall be tested by the contractor as part of the inspection process, using a qualified tester and suitable testing equipment. The contractor shall notify the JWSC Inspector at least 48 hours in advance of the locate wire field testing schedule.

2.5.3.7 Casing Spacers

All carrier pipes located within steel casings shall be installed utilizing casing spacers in accordance with the **JWSC Standard Details**. Casing spacers shall be installed one (1) foot on either side of each carrier pipe joint and at no more than ten (10) foot intervals along the pipe. A casing spacer shall also be installed within two feet of the ends of the casing pipe. See paragraph 2.4.7.4 for material specifications.

2.5.3.8 Pressure and Leakage Testing

Upon completion of backfilling operations and prior to disinfection, all completed water lines shall be subject to hydrostatic (pressure and leakage) testing in accordance with AWWA C600 or AWWA C605 as appropriate and as outlined below. Pressure and leakage testing shall be conducted simultaneously. The contractor shall test all new water lines in the presence of a JWSC Inspector.

The test pressure shall be measured at the lowest point. All required blow offs shall be installed by the contractor prior to the hydrostatic test. See also paragraph 2.5.7.10 below for required sampling locations for bacteriological testing.

The contractor shall furnish clean water as well as temporary plugs, caps, bulkheads, test pump and all other necessary equipment and labor for the test. The section of water main to be tested shall be filled with water of approved quality and all air shall be expelled from the pipe. Water for testing may be obtained from any existing fire hydrant or special wet tap of an existing water line provided that the method of backflow prevention used is approved by the JWSC Inspector.

The JWSC will operate all valves and hydrants on the existing water distribution system. If blow offs or other outlets are not available at high points for releasing air, the contractor shall make the necessary taps at such points and shall plug such holes at the completion of the test. The Table below lists the approximate amount of water which must be added to the pipe to raise line pressure from 0 to 150 PSI when no air is present.

**Figure WD-3
Water / Pipe Ratio Table**

Pipe Diameter	Gallons/1000 LF
6"	0.73
8"	1.31
10"	2.04
12"	2.94
16"	5.22

If the actual field test quantities (additional water amount) is over 4 times greater than the amounts listed in the table above, severe air entrapment is likely and additional efforts should be made to expel air from the pipe prior to testing.

All piping shall be pressure and leakage tested for a minimum of 2-hours duration at 150 PSI. All valved sections shall be hydrostatically tested to ensure sealing (leak allowance) of all line valves. During the 2-hour test period, no pipe will be accepted if pressure loss is greater than 5 PSI regardless of the leakage test results. The allowable testing leakage shall not exceed 11.65 GPD/Mile/inch of nominal diameter at a pressure of 150 PSI. If the initial test results are unsatisfactory, damaged or defective pipe, fittings and valves shall be repaired or replaced and the test repeated until satisfactory results are obtained.

2.5.3.9 Disinfection of Water Mains

Upon satisfactory completion of the hydrostatic test, all new water lines and other pipe related installations which may have been contaminated by the work shall be disinfected in accordance with AWWA C651, the Rules for Safe Drinking Water as published by the Georgia Environmental Protection Division, and as outlined below. The contractor shall disinfect all new water lines in the presence of a JWSC Inspector.

Prior to disinfection, water lines shall be thoroughly flushed to remove contaminated materials from the line. The contractor is referred to AWWA C651 for precautions during construction and procedures for flushing.

Disinfection shall be accomplished by introducing chlorine into the main to be disinfected. The disinfection procedure used may be any of the methods or procedures outlined in AWWA C651. A chlorine residual of at least 25 milligrams per liter (mg/l) shall be maintained for 24 hours in the water line to be disinfected. After the 24 hour holding or contact period, the heavily chlorinated water shall be flushed from the main until the chlorine residual within the main reaches the level of chlorine normally carried in the distribution system (1.0 mg/l). De-chlorination of the flushing water may be required if the highly chlorinated water is to be discharged directly to a surface water stream or storm drain system. If the water can be sheet-flowed over a large area or discharged to a holding pond, de-chlorination may be avoided.

After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24-hours apart, shall be collected from the new main.

At least one set of samples shall be collected from every twelve-hundred (1200) linear feet of new water main, plus one set from the end of each line and at least one set from each branch. The JWSC Water Compliance Coordinator, in conjunction with the JWSC inspector, will determine the number and location of the required sampling points to meet the current standards. All required sampling taps shall be installed by the contractor, at his expense, prior to disinfection.

The collection of samples and bacteriological testing will be performed by the JWSC at the Contractor's expense unless noted otherwise on the construction plans. If the bacteriological tests are unsatisfactory, disinfection procedure shall be repeated until satisfactory results are obtained.

2.5.4 Valves and Appurtenances

2.5.4.1 Valves

All buried valves shall be carefully mounted in their respective positions free from distortion and strain. Valves shall be placed as shown on the drawings. Unless noted otherwise in line valve spacing shall be every eight-hundred (800) feet (maximum) in residential/rural locations and every five-hundred (500) feet (maximum) in commercial and industrial areas. Gate valves shall be installed as near as possible to tee and cross fittings. The contractor shall check all exposed bolts on all valves to ensure that they are tight prior to installation.

Where required, extension stems shall be furnished and located as directed by the JWSC.

Adjustable valve boxes shall be installed with each buried valve, placed vertically and concentric with the valve stem. Any valve box which has been moved from its original position by trench settlement or other causes, and which prevents the use of a valve wrench for opening and closing of the valve, shall be reset by the Contractor prior to final acceptance. The entire assembly shall be plumb.

In unpaved areas, a poured in place reinforced concrete valve pad shall be installed around all valve boxes. The concrete thickness shall be four (4) inches for poured in place collars. The top of poured in place collar shall be level with the top of the cast iron valve box and level with the **final grade**. A typical buried valve installation is shown on the **JWSC Standard Details**.

2.5.4.2 Fire Hydrants

Immediately before installation of the fire hydrant, the hydrant shall be thoroughly inspected and cleaned; and shall be opened and closed to determine if all parts are in working order with valves seating properly and drain valve operating freely. All fire hydrants shall have a minimum cover of 36-inches over the branch supply line and shall be restrained as shown on the **JWSC Standard Details**. The hydrant assembly includes the hydrant tee, six (6) inch hydrant supply pipe, six (6) inch gate valve and valve box, tie rods and all other appurtenances as shown on the aforementioned detail.

Hydrant drainage shall be provided by installing at least seven (7) cubic feet of No.57 gravel around the hydrant and below the top of the hydrant supply pipe. The barrel of the hydrant shall be set plumb with the lowest discharge outlet at least fifteen (15) inches and no more than twenty four (24) inches above **final grade**.

The minimum spacing for fire hydrants shall be 500 feet unless directed otherwise by the JWSC. No fire hydrant shall be installed within ten (10) feet of any private or commercial driveway unless directed by the JWSC.

2.5.5 System Connections

Unless otherwise approved, all connections and ties to the existing public water system shall be performed by the JWSC upon payment of applicable fees.

2.5.5.1 Water Main Connections

No taps shall be made within 5 pipe diameters or five (5) feet (whichever is smaller) of a joint. The contractor/developer shall coordinate the tap with the JWSC and pay all applicable fees.

The contractor/developer shall furnish and install the required tapping saddle and tapping valve in accordance with JWSC Standards, after which JWSC personnel will make the actual tap to the main. A typical water main connection is shown on the **JWSC Standard Details**.

2.5.5.2 Water Service Connections

(5/8-inch Meter):

All water service connections to mains within new developments under construction and not yet accepted by the JWSC shall be performed in accordance with the JWSC Standards and shall include service tap, corporation stop, service tubing, curb stop and meter box. Water meters will be installed by the JWSC. Water service connections to existing mains shall be made by the JWSC upon payment of all operational, impact and account setup fees. No service taps shall be made within 5 pipe diameters or 5-feet (whichever is smaller) of a joint. Service tubing shall be as specified in paragraph 2.4.1.3 above. Typical residential water service details for single, double or multiple service lines are shown on the **JWSC Standard Details**.

(1-1/2-inch and larger):

Water service connections to existing mains shall be made by the JWSC. The contractor/developer shall coordinate the tap with the JWSC and pay all applicable fees. The contractor/developer shall furnish and install the required tapping saddle and tapping valve in accordance with JWSC standards, after which JWSC personnel will make the actual tap to the main. No service taps shall be knowingly made within five (5) pipe diameters or five (5) feet (whichever is smaller) of a joint. Water meters will be obtained from the JWSC but may be installed by a licensed plumber or utility contractor. Unless otherwise approved, meters shall be installed in vaults below ground. Above ground installations may be approved on a case by case basis. Meters one and one-half (1 ½) inches and larger shall be installed with a bypass. Typical large meter installation details are shown on the ***JWSC Standard Details***.

2.5.5.3 Backflow Prevention Devices

Backflow prevention devices shall be installed in accordance with applicable state and local ordinances. Double check valve assemblies shall be used in low to medium (non-health) hazard locations such as restaurants, lawn sprinkler systems, swimming pools, fire sprinkler systems, etc.

For high (health) hazard locations such as hospitals, medical clinics, car wash facilities, wastewater treatment plants, pumping stations, etc., a reduced pressure zone (RPZ) assembly shall be used. Fire suppression systems utilizing reclaimed water or other chemicals and additives are also considered high hazard locations. Typical installation requirements are shown on the ***JWSC Standard Details***.

APPENDIX 2A
ACCEPTABLE MANUFACTURERS

APPENDIX 2A

WATER DISTRIBUTION SYSTEM
ACCEPTABLE MANUFACTURERS

PARAGRAPH	PRODUCT	MANUFACTURERS
2.4.1	Potable Water Pipe	
2.4.1.1	<i>Ductile Iron Pipe</i>	American Cast Iron Pipe Company U.S. Pipe and Foundry Clow McWane
2.4.1.2	<i>Polyvinyl Chloride (PVC) Pipe</i>	J.M. Eagle Blue Brute Diamond Plastics Corporation North American Pipe Corporation National Pipe and Plastics Vulcan
2.4.1.3	<i>Polyethylene Tubing</i>	Charter, ADS
2.4.1.4	<i>High Density Polyethylene (HDPE) Pipe</i>	Performance, JM, Lamson
2.4.1.5	<i>Steel Casing Pipe</i>	See note 1 N/A
2.4.2	Fittings	
2.4.2.1	<i>Ductile Iron</i>	American Cast Iron Pipe Company U.S. Pipe and Foundry Clow McWane
2.4.2.2	<i>PVC</i>	J.M. Eagle Blue Brute Diamond Plastics Corporation North American Pipe Corporation National Pipe and Plastics Vulcan
2.4.2.3	<i>Non-Standard Fittings and Wall Castings</i>	See note 1
2.4.3	Joints	
2.4.3.3	<i>Mechanical Joint Restraints</i>	EBAA Iron Sales
	<i>Harness (Bell) Restraints</i>	EBAA Iron Sales
2.4.4	Valves and Appurtenances	
2.4.4.1	<i>Gate Valves (4" and Larger)</i>	Clow Mueller
	<i>Gate Valves (2")</i>	Matco
2.4.4.2	<i>Fire Hydrants</i>	Clow Medallion Mueller Supercenturian
2.4.4.3	<i>Valve Boxes</i>	Star Segma
2.4.4.4	<i>Tapping Sleeves</i>	JCM Smith Blair
2.4.5	Water Services and Appurtenances	
2.4.5.1	<i>Corporation Stops</i>	Mueller Ford

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PARAGRAPH	PRODUCT	MANUFACTURERS
2.4.5.2	<i>Curb Stops</i>	Mueller Ford
2.4.5.3	<i>Double Strapped Tapping Saddles</i>	JCM
2.4.5.4	<i>Meter Boxes (Residential)</i>	Pentair
2.4.5.5	<i>Meter Boxes (1-1/2" and 2" Meters)</i>	Pentair
2.4.6	Backflow Prevention Devices	
2.4.6.1	<i>Double Check Valve (DCV) Assemblies</i>	Watts, Hersey, Febco
2.4.6.2	<i>Reduced Pressure Zone (RPZ) Assemblies</i>	Watts, Hersey, Febco
2.4.7	Miscellaneous Items	
2.4.7.1	<i>Detection Tape</i>	Omega, Proline
2.4.7.2	<i>Tracer Wire</i>	Copperhead, Apex
2.4.7.3	<i>Polyethylene Wrap</i>	Trumbull
2.4.7.4	<i>Casing Spacers</i>	BWM, Cascade
2.4.7.5	<i>End Seals</i>	BWM, Cascade

Note:

1. Where no manufacturer is listed for a particular item of material or equipment, the contractor may select the manufacturer provided that all requirements of these standards for that particular item of material or equipment are met. Submittals of such items are required.

APPENDIX 2B
STANDARD CONSTRUCTION DETAILS

SECTION 3
GRAVITY SEWER SYSTEMS

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SECTION 3 GRAVITY SEWER SYSTEMS

3.1 GENERAL

This section provides the minimum guidelines for the design of gravity sanitary sewer collection systems. The method of design and/or construction shall be according to these Design and Construction Standards and Specifications and the following:

*Recommended Standards for Sewage Works (Ten State Standards)
Latest Edition*

*Georgia Environmental Protection Division State of Georgia Regulations
for Water and Sewerage Works, Latest Edition*

Applicable Federal, State and Local Requirements

In the event of conflicts among the various sources cited above, the most stringent criteria shall take precedence.

3.2 DESIGN FLOWS

Each system component shall be designed to meet certain flow requirements. The various flow requirements are described below.

3.2.1 Daily Average Dry Weather Flow (ADWF)

Daily Average Dry Weather Flow (ADWF) shall be 300 gallons per day per Residential Equivalent Unit (REU) or 115 gallons per day per capita. The basis for one (REU) shall be a single-family unit occupied by an average of 2.6 persons. Where sewer service beyond the basis of the established REU is required, the Sewage Flow Table shown below (adapted from the Georgia Environmental Division Large Community Design Guidance Document, Pages 8 & 9, Appendix A) shall be used.

**Figure GS-1
Sewage Flow Table**

FACILITY	Gallons/Day (GPD)
Assembly Hall	5 per seat
Barber Shop/Beauty Parlor	125 per chair + 20/employee
Boarding House*	100 per room
Bowling Alley	75 per lane + 20/employee
Church w/o Day Care or Kindergarten	5 per sanctuary seat
Correctional Institution/Prison	250 per inmate
Country Club, Recreation Facilities Only	25 per member
Day Care Center, No Meals	15 per person
Dental Office	100 per chair + 20/employee
Department Store	10 per 100 SF
Factory	
Without Showers	25 per employee
With Showers	35 per employee
Food Service Establishments*	
Restaurants (Up to 12 hours per day)	35 per seat + 20/employee
Restaurants (12 hours per day to 18 hours per day)	50 per seat + 20/employee
Restaurants (Above 18 hours per day)	75 per seat + 20/employee
Bar and Cocktail Lounge	30 per seat + 20/employee
Drive-in Restaurant	50 per space + 20/employee
Carry-out Only	50 per 100 SF + 20/employee
Funeral Home	10 per 100 SF
Hospital	
Inpatient	300 per bed
Outpatient	275 per bed
Hotel*	100 per room
Kindergarten, No Meals	15 per person
Laundry, Commercial	1,000 per machine
Laundry, Coin	150 per machine
Lodges*	100 per room
Mobile Home Park	300 per site
Motel*	100 per room
Nursing Home*	150 per bed
Office	10 per 100 SF
Physician's Office	200 per exam room
Schools*	
Boarding	100 per person
Day, Restrooms Only	12 per person
Day, Restrooms and Cafeteria	16 per person
Day, Restrooms, Gym and Cafeteria	20 per person
Service Stations, Interstate Locations	425 + 150 per pump
Service Stations, Other Locations	300 + 100 per pump
Service Station Car Wash	500 per stall
Shopping Center (Not including food service or laundry)	10 per 100 SF
Stadium	5 per seat
Supermarket/Grocery Store	20 per 100 SF
Theater	5 per seat

FACILITY	Gallons/Day (GPD)
Travel Trailer Park*	
With Independent Water & Sewer Connection	175 per site
Without Independent Water & Sewer Connection	35 per site
Warehouse	10 per 100 SF
*Add 300 gallons per machine to amount indicated if laundry or dish washing machines are installed	

Note: Where historical data is available from flow monitoring or other approved devices as in the case of existing systems, ADWF shall be as averaged from seven (7) days within the monitoring period of flow with no rainfall event greater than .5 (5/10ths) inches of rain in any of the seven 24-hour periods being averaged.

3.2.2 Calculation of Peak Flow (PF)

For gravity systems, the Daily Average Dry Weather Flow (ADWF) to be conveyed must be adjusted to allow for the maximum diurnal or peak flow that is expected to occur as follows:

$$\text{Peak Flow} = \text{PF} \times \text{Average Dry Weather Flow (ADWF)}$$

Where:

Peaking Factor = PF = $5 / P^{0.1667}$ as referenced in ASCE Manual and Reports of Engineering Practice #60 and WPCF Manual of Practice #FD-5, (Babbitt Equation);

Population = P = used as P/1,000 in the equation with each 300 GPD (REU) considered as serving 2.6 persons as follows:

For residential use, (i.e. 5 single family residences times 2.6 persons/residence = 13 and $13/1,000 = P = 0.013$);

For Commercial Use, by dividing the total calculated GPD from the EPD Sewage Flow Table (Figure GS-1) by 300 GPD/REU and multiplying the REU's by 2.6, (i.e. $4,000 \text{ GPD} / 300 \text{ GPD} = 13.3 \text{ REU's} \times 2.6 \text{ persons/REU} = 35$ and $35/1,000 = P = 0.035$);

For Industrial Use, by employee count GPD from EPD Sewage Flow Table (Figure GS-1) divided by 300 GPD/REU and then multiplying the REU's by 2.6 persons/REU to approximate employee population, plus the maximum gallon per minute wastewater discharge capability, (as provided by the process design engineer), multiplied by 1,440 minutes/day and divided by 300 GPD to obtain REU's then multiplying the REU's by 2.6 to obtain an approximate equivalent population for process flow, (i.e. 25 factory employee @ 30 GPD = 900 GPD/300 GPD = 3 REU's X 2.6 persons/REU = 8 and peak process water discharge @ 150 GPM X 1,440min/day = 216,000 GPD/300 GPD per REU = 720 REU's X 2.6 persons/REU = 1,872, then 1,872 for process water population approximation + 8 factory employee population approximation = 1,880 and 1,880/1,000 = P = 1.88).

3.3 SIZING OF GRAVITY SEWER MAINS

3.3.1 Major Outfalls

The size of major outfall sewers or extensions to such mains, throughout the system shall be in accordance with JWSC Water and Sewer Master Plan, latest revision. Contact the Planning and Construction Division for additional information and guidance with regard to this requirement.

3.3.2 Collector Sewers

All gravity sewer mains shall be designed to convey the Design Peak Flow at a flow depth not to exceed 94% of the pipe inside diameter or less than 0.6 inches, and at a self-cleansing velocity of between 1.99 FPS and 2.01 FPS. Gravity sewer mains intended for public use and JWSC operation and maintenance shall be sized to meet these hydraulic guidelines with the minimum pipe size being 8-inches in diameter, unless specifically allowed subject to the 6-inch pipe diameter exceptions cited in paragraph 3.4.2 below.

3.4 GRAVITY SEWER MAIN PIPE SLOPE REQUIREMENTS

3.4.1 Discussion

The major items for consideration in the regulation of gravity sewer pipe slopes are carrying capacity at peak flow and self-cleansing velocity. The inability to convey peak flow results in system surcharging and potential sanitary sewer overflows. The lack in the development of self-cleansing velocity, at least during the flows diurnal peak, results in solids deposition, system odors, and the eventual reduction in pipe capacity leading to blockages and overflows.

An additional consideration in the JWSC jurisdictional area, and numerous other coastal areas, is wastewater piping system detention time. Lengthy wastewater detention or travel time through gravity piping systems encourages the development of corrosive and odorous gases that damage piping infrastructure, cause odor complaints and increase the cost of system operation by requiring the addition of chemicals to inhibit or mitigate the effects of aging wastewater. Therefore, design of gravity sewer systems in this standard shall stress the development of self-cleansing velocities as the most practical and effective method of minimizing wastewater detention times in sewer mains.

Standardized slopes, as recommended by Ten States Standards in concert with the minimum pipe diameters and minimum flow depths suggested in these guidelines, often forces the designer to hold to a pipe grade that does not provide adequate velocities at “projected” flow rates and/or forces a pipe grade that shortens the potential reach of a proposed sewer main when projected flow rates would develop self-cleansing velocity at a lesser grade.

In an effort to address these aforementioned issues, the JWSC’s pipe slope design requirements are developed to provide a range of acceptable pipe slopes based on good hydraulic engineering practice using “projected” pipe flow rates based on REU’s and peaking factors as defined by appropriate engineering literature, organizational experience, policy and regulatory guidelines.

3.4.2 Gravity Sewer Main Grades

Gravity sewer mains intended for public use and O&M by the JWSC or extensions to public systems which are to remain private shall be in accordance with the preferred slopes shown in Figure GS-2 for minimum pipe diameters. Where adherence to the minimum eight (8) inch pipe diameter will not develop self-cleansing velocities at “projected” ultimate contributory flows, six (6) inch diameter pipe may be used, if approved as an exception, defined as follows.

A six (6) inch diameter pipe exception shall only apply for limited reaches of gravity sewer where self-cleansing velocities can not be developed in eight (8) inch pipes by “projected” flow peaks during the 24-hour diurnal cycle; and when such gravity mains are strategically located such that system expansion from those lines is highly improbable, as in the case of limited boundary development subdivisions.

The use of the Manning Equation indicates that flows in excess of 12,000 gpd and peak flows of 61 gpm, using the Babbitt Peaking Equation, are needed to develop self-cleaning velocities at the diurnal peak in an eight (8) inch line on a grade of 0.40%. This equates to 39 single family residences or REU's. The six (6) inch pipe diameter exception shall be considered valid when this quantity of "projected" contributory flow for any gravity sewer reach is not available.

Grades for pipe diameters greater than the cited six (6) inch and eight (8) inch minimums shall be based on the same design criteria as stated above in article 3.3.2, and in consideration of "projected" flows. Alternatives to the six (6) inch exception include low pressure systems, step systems, vacuum systems or on-site treatment systems.

The maximum slope for all pipe diameters shall be such that the velocity in the pipes does not exceed 5 fps at 94% of the pipe inside diameter when calculated using Manning's Equation and projected flow peaks.

Figure GS-2
Gravity Sewer Main Pipe Slope Table for six (6) inch and eight (8) inch Pipes
Using Manning Flow and Babbitt PF Equations

Nominal Diameter	Pipe Material	Projected Flow (REU's)	Projected Population	Calculated Peaking Factor	Projected ADWF (GPD)	Projected Peak Flow (GPM)	Self Cleansing Minimum Slope (%)	Flow Depth (Inches)	Maximum Capacity @ Minimum Slope (GPM)
6	PVC HDPE	4	10.4	10.7	1,200	9	1.75	0.61	467
6	PVC HDPE	5	13.0	10.3	1,500	11	1.53	0.68	437
6	PVC HDPE	6	15.6	10.0	1,800	13	1.35	0.75	410
6	PVC HDPE	7	18.2	9.7	2,100	14	1.25	0.80	395
6	PVC HDPE	8	20.8	9.5	2,400	16	1.11	0.88	372
6	PVC HDPE	9	23.4	9.3	2,700	18	1.02	0.94	357
6	PVC HDPE	10	26.0	9.2	3,000	19	0.95	1.00	344
6	PVC HDPE	11	28.6	9.0	3,300	21	0.89	1.05	333
6	PVC HDPE	12	31.2	8.9	3,600	22	0.86	1.09	328
6	PVC HDPE	13	33.8	8.8	3,900	24	0.80	1.15	316
6	PVC HDPE	14	36.4	8.7	4,200	25	0.76	1.20	308
6	PVC HDPE	15	39.0	8.6	4,500	27	0.72	1.26	300
6	PVC HDPE	16	41.6	8.5	4,800	28	0.69	1.30	293
6	PVC HDPE	17	44.2	8.4	5,100	30	0.66	1.35	287
6	PVC HDPE	18	46.8	8.3	5,400	31	0.64	1.39	283

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Nominal Diameter	Pipe Material	Projected Flow (REU's)	Projected Population	Calculated Peaking Factor	Projected ADWF (GPD)	Projected Peak Flow (GPM)	Self Cleansing Minimum Slope (%)	Flow Depth (Inches)	Maximum Capacity @ Minimum Slope (GPM)
6	PVC HDPE	19	49.4	8.3	5,700	33	0.62	1.44	278
6	PVC HDPE	20	52.0	8.2	6,000	34	0.59	1.49	271
6	PVC HDPE	21	54.6	8.1	6,300	36	0.57	1.54	267
6	PVC HDPE	22	57.2	8.1	6,600	37	0.55	1.59	262
6	PVC HDPE	23	59.8	8.0	6,900	38	0.54	1.62	260
6	PVC HDPE	24	62.4	7.9	7,200	40	0.52	1.67	255
6	PVC HDPE	25	65.0	7.9	7,500	41	0.51	1.70	252
6	PVC HDPE	26	67.6	7.8	7,800	42	0.50	1.73	250
6	PVC HDPE	27	70.2	7.8	8,100	44	0.48	1.79	245
6	PVC HDPE	28	72.8	7.7	8,400	45	0.48	1.80	245
6	PVC HDPE	29	75.4	7.7	8,700	46	0.47	1.83	242
6	PVC HDPE	30	78.0	7.6	9,000	48	0.45	1.90	237
6	PVC HDPE	31	80.6	7.6	9,300	49	0.44	1.94	234
6	PVC HDPE	32	73.2	7.6	9,600	50	0.44	1.96	234
6	PVC HDPE	33	85.8	7.5	9,900	52	0.42	2.03	229
6	PVC HDPE	34	88.4	7.5	10,200	53	0.42	2.04	229
6	PVC HDPE	35	91.0	7.5	10,500	54	0.41	2.07	226
6	PVC HDPE	36	93.6	7.4	10,800	56	0.40	2.12	223
6	PVC HDPE	37	96.2	7.4	11,100	57	0.39	2.17	221
6	PVC HDPE	38	98.8	7.4	11,400	58	0.39	2.19	221
6	PVC HDPE	39	101.4	7.3	11,700	59	0.38	2.22	218
6	PVC HDPE	40	104.0	7.3	12,000	61	0.38	2.25	218
8	PVC HDPE	40	104.0	7.3	12,000	61	0.40	2.00	481
8	PVC HDPE	41	106.6	7.3	12,300	62	0.40	2.01	481
8	PVC HDPE	42	109.2	7.2	12,600	63	0.39	2.04	475
8	PVC HDPE	43	111.8	7.2	12,900	65	0.39	2.07	475
8	PVC HDPE	44	114.4	7.2	13,200	66	0.38	2.10	469
8	PVC HDPE	45	117.0	7.1	13,500	67	0.38	2.12	469
8	PVC HDPE	46	119.6	7.1	13,800	68	0.37	2.15	463
8	PVC HDPE	47	122.2	7.1	14,100	69	0.37	2.17	463
8	PVC HDPE	48	124.8	7.1	14,400	71	0.36	2.21	456

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Nominal Diameter	Pipe Material	Projected Flow (REU's)	Projected Population	Calculated Peaking Factor	Projected ADWF (GPD)	Projected Peak Flow (GPM)	Self Cleansing Minimum Slope (%)	Flow Depth (Inches)	Maximum Capacity @ Minimum Slope (GPM)
8	PVC HDPE	49	127.4	7.0	14,700	72	0.35	2.25	450
8	PVC HDPE	50	130.0	7.0	15,000	73	0.34	2.28	444
8	PVC HDPE	51	132.6	7.0	15,300	74	0.34	2.30	444
8	PVC HDPE	52	135.2	7.0	15,600	76	0.34	2.32	444
8	PVC HDPE	53	137.8	7.0	15,900	77	0.34	2.34	444
8	PVC HDPE	54	140.4	6.9	16,200	78	0.33	2.38	437
8	PVC HDPE	55	143.0	6.9	16,500	79	0.33	2.39	437
8	PVC HDPE	56	145.6	6.9	16,800	80	0.32	2.43	430
8	PVC HDPE	57	148.2	6.9	17,100	82	0.32	2.45	430
8	PVC HDPE	58	150.8	6.9	17,400	83	0.32	2.47	430
8	PVC HDPE	59	153.4	6.8	17,700	84	0.31	2.51	424
8	PVC HDPE	60	156.0	6.8	18,000	85	0.31	2.52	424
8	PVC HDPE	61	158.6	6.8	18,300	86	0.31	2.54	424
8	PVC HDPE	62	161.2	6.8	18,600	88	0.30	2.60	417
8	PVC HDPE	63	163.8	6.8	18,900	89	0.30	2.61	417
8	PVC HDPE	64	166.4	6.7	19,200	90	0.30	2.62	417
8	PVC HDPE	65	169.0	6.7	19,500	91	0.29	2.66	410
8	PVC HDPE	66	171.6	6.7	19,800	92	0.29	2.68	410
8	PVC HDPE	67	174.2	6.7	20,100	93	0.29	2.69	410
8	PVC HDPE	68	176.8	6.7	20,400	95	0.28	2.75	403
8	PVC HDPE	69	179.4	6.7	20,700	96	0.28	2.76	403
8	PVC HDPE	70	182.0	6.6	21,000	97	0.28	2.78	403
8	PVC HDPE	71	184.6	6.6	21,300	98	0.28	2.79	403
8	PVC HDPE	72	187.2	6.6	21,600	99	0.27	2.83	395
8	PVC HDPE	73	189.8	6.6	21,900	100	0.27	2.85	395
8	PVC HDPE	74	192.4	6.6	22,200	101	0.27	2.86	395
8	PVC HDPE	75	195.0	6.6	22,500	103	0.27	2.89	395
8	PVC HDPE	76	197.6	6.6	22,800	104	0.26	2.94	388
8	PVC HDPE	77	200.2	6.5	23,100	105	0.26	2.96	388
8	PVC HDPE	78	202.8	6.5	23,400	106	0.26	2.97	388
8	PVC HDPE	79	205.4	6.5	23,700	107	0.26	2.98	388

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Nominal Diameter	Pipe Material	Projected Flow (REU's)	Projected Population	Calculated Peaking Factor	Projected ADWF (GPD)	Projected Peak Flow (GPM)	Self Cleansing Minimum Slope (%)	Flow Depth (Inches)	Maximum Capacity @ Minimum Slope (GPM)
8	PVC HDPE	80	208.0	6.5	24,000	108	0.26	3.00	388
8	PVC HDPE	81	210.6	6.5	24,300	109	0.26	3.01	388
8	PVC HDPE	82	213.2	6.5	24,600	111	0.25	3.08	380
8	PVC HDPE	83	215.8	6.5	24,900	112	0.25	3.10	380
8	PVC HDPE	84	218.4	6.4	25,200	113	0.25	3.11	380
8	PVC HDPE	85	221.0	6.4	25,500	114	0.25	3.13	380
8	PVC HDPE	86	223.6	6.4	25,800	115	0.24	3.18	373
8	PVC HDPE	87	226.2	6.4	26,100	116	0.24	3.19	373
8	PVC HDPE	88	228.8	6.4	26,400	117	0.24	3.21	373
8	PVC HDPE	89	231.4	6.4	26,700	118	0.24	3.22	373
8	PVC HDPE	90	234.0	6.4	27,000	119	0.24	3.23	373
8	PVC HDPE	91	236.6	6.4	27,300	121	0.24	3.26	373
8	PVC HDPE	92	239.2	6.3	27,600	122	0.23	3.32	365
8	PVC HDPE	93	241.8	6.3	27,900	123	0.23	3.33	365
8	PVC HDPE	94	244.4	6.3	28,200	124	0.23	3.35	365
8	PVC HDPE	95	247.0	6.3	28,500	125	0.23	3.36	365
8	PVC HDPE	96	249.6	6.3	28,800	126	0.23	3.37	365
8	PVC HDPE	97	252.2	6.3	29,100	127	0.23	3.39	365
8	PVC HDPE	98	254.8	6.3	29,400	128	0.23	3.40	365
8	PVC HDPE	99	257.4	6.3	29,700	129	0.22	3.47	357
8	PVC HDPE	100	260.0	6.3	30,000	130	0.22	3.48	357
8	PVC HDPE	101	262.6	6.2	30,300	131	0.22	3.49	357
8	PVC HDPE	102	265.2	6.2	30,600	133	0.22	3.52	357
8	PVC HDPE	103	267.8	6.2	30,900	134	0.22	3.54	357
8	PVC HDPE	104	270.4	6.2	31,200	135	0.22	3.56	357
8	PVC HDPE	105	273.0	6.2	31,500	136	0.22	3.57	357
8	PVC HDPE	106	275.6	6.2	31,800	137	0.22	3.58	357
8	PVC HDPE	107	278.2	6.2	32,100	138	0.21	3.65	349
8	PVC HDPE	108	280.8	6.2	32,400	139	0.21	3.66	349
8	PVC HDPE	109	283.4	6.2	32,700	140	0.21	3.68	349
8	PVC HDPE	110	286.0	6.2	33,000	141	0.21	3.68	349

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Nominal Diameter	Pipe Material	Projected Flow (REU's)	Projected Population	Calculated Peaking Factor	Projected ADWF (GPD)	Projected Peak Flow (GPM)	Self Cleansing Minimum Slope (%)	Flow Depth (Inches)	Maximum Capacity @ Minimum Slope (GPM)
8	PVC HDPE	111	288.6	6.2	33,300	142	0.21	3.70	349
8	PVC HDPE	112	291.2	6.1	33,600	143	0.21	3.72	349
8	PVC HDPE	113	293.8	6.1	33,900	144	0.21	3.73	349
8	PVC HDPE	114	296.4	6.1	34,200	145	0.21	3.75	349
8	PVC HDPE	115	299.0	6.1	34,500	146	0.21	3.76	349
8	PVC HDPE	116	301.6	6.1	34,800	148	0.20	3.85	340
8	PVC HDPE	117	304.2	6.1	35,100	149	0.20	3.87	340
8	PVC HDPE	118	306.8	6.1	35,400	150	0.20	3.88	340
8	PVC HDPE	119	309.4	6.1	35,700	151	0.20	3.90	340
8	PVC HDPE	120	312.0	6.1	36,000	152	0.20	3.91	340
8	PVC HDPE	121	314.6	6.1	36,300	153	0.20	3.92	340
8	PVC HDPE	122	317.2	6.1	36,600	154	0.20	3.94	340
8	PVC HDPE	123	319.8	6.0	36,900	155	0.20	3.95	340
8	PVC HDPE	124	322.4	6.0	37,200	156	0.20	3.97	340
8	PVC HDPE	125	325.0	6.0	37,500	157	0.20	3.98	340
8	PVC HDPE	126	327.6	6.0	37,800	158	0.20	4.00	340
8	PVC HDPE	127	330.2	6.0	38,100	159	0.20	4.01	340
8	PVC HDPE	128	332.8	6.0	38,400	160	0.19	4.09	332

Notes For Table GS-2:

1. REU (GPD) = 300
2. Plastic Pipe Manning "n" = 0.010 (For clean pipe with little deposits/debris)
3. Metal Pipe Manning "n" = 0.013 (For clean pipe with little deposits/debris)
4. Required Self-Cleansing Velocity = 1.99 to 2.01 feet per second
5. Minimum Pipe Flow Depth = 0.6 inches

3.5 MATERIAL SPECIFICATIONS

The contractor shall furnish gravity sewer piping systems in accordance with the material specifications detailed below. All references to industry standards (ASTM, ANSI, AWWA, etc.) shall be to the latest revision unless stated otherwise. All materials shall be new. These material specifications include a list of acceptable manufacturers for the various water system components. The contractor may choose freely from the manufacturers list and **material submittals for such items are not required**. Only products and materials from the acceptable manufacturer's lists herein may be used in the work.

Any item required but not specified herein, or any product or manufacturer other than those listed will be considered a substitution. ***Material submittals are required for such items.*** Substitutions will not be allowed without the prior written approval of the JWSC Planning and Construction Division. Substitutions, if allowed, shall meet all criteria of the detailed specifications. The burden of proof of compliance for any proposed substitution rests with the Contractor/Developer/Owner. The JWSC Planning and Construction Division will be the sole judge as to the acceptance of a proposed substitution and such decisions will be final.

3.5.1 General Considerations

The type, class, grade, and alignment of sewer pipe may be changed only at manholes. The only exception to this being where a gravity sewer main crosses under a storm drain and the invert of the storm drain is less than 3 feet above the crown of the sewer main. In such cases, a full twenty (20) foot joint of ductile iron pipe shall be centered under the storm drain and joined to PVC or HDPE pipe with a mechanical joint or stress resistant coupling.

Gravity sewer mains shall be ASTM 3034, SDR-26 heavy wall sewer pipe or DR-17 HDPE. Gravity sewer mains within steel casings or PVC DR18 casing pipes shall be ASTM 3034, SDR 26 heavy wall sewer pipe and shall be installed with approved skids or spacers to hold grade and prevent flotation in accordance with these specifications.

Ductile iron pipe is only permitted for gravity sewer use where the mains or laterals are above ground as in ditch crossings. The only exception being storm drain crossings as cited above.

All material shall be free from defects impairing strength and durability, shall be of the best commercial quality for the purpose specified, shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

Pipe to be installed underground using open-cut methods shall be PVC push-on joint type as described in these specifications, or as accepted within these specifications for storm drain crossings. Pipe installed above ground shall be Sewer-Safe restrained joint ductile iron pipe or flanged ductile iron pipe as described in these specifications.

For pipe bursting or horizontal boring construction, the pipe shall be high density polyethylene (HDPE) or Fusible PVC of a suitable ASTM Standard, classification and pressure rating as described in these specifications. The “depth of cut” shall be defined as the vertical distance from pipe invert to finish grade.

3.5.2 Polyvinyl Chloride (PVC) Pipe and Fittings

Each length shall be clearly marked with the name of the manufacturer, location of the plant, pressure rating, nominal pipe diameter and length. All PVC sanitary sewer pipe shall be green. Storage and handling of PVC pipe shall be in accordance with Chapter 6 of AWWA Manual M23.

PVC 1120, Class 160, SDR 26 Pipe shall conform to ASTM D3034 for sizes four (4) inch thru fifteen (15) inch diameter pipe and ASTM F679 for 18 inch through 36 inch diameter pipe.

The pipe material shall be clean, virgin, National Sanitation Foundation approved, Class 12454-B PVC compound conforming to ASTM resin specification D1784 with wall thickness T-1. Pipe shall have a bell type coupling with a thickened wall section integral with the pipe barrel in accordance with ASTM D3212. Elastomeric seals shall meet ASTM F477 or ASTM F913. The pipe shall be designed to pass without failure a sustained pressure test of 340 psi in conformance with ASTM D1598 and a quick burst test of 400 psi in conformance with ASTM D1599.

Fittings shall meet the requirements of ASTM D3034 and ASTM F1336 for sizes four (4) inch through fifteen (15) inch in diameter and ASTM F679 and ASTM F1336 for eighteen (18) inch through thirty six (36) inch in diameter with minimum wall thickness of SDR 26. Fittings shall be gasket joint type meeting the requirements of ASTM D3212. Elastomeric gaskets shall conform to ASTM F477 or ASTM F913. PVC material shall have a cell classification of 12454-B in accordance with ASTM D1784.

PVC 1120, Pressure Class (PC) 235 of DR-18 for twenty-four (24) inch diameter or less and DR-21 for greater than twenty-four (24) inch diameter pipe (used as casing pipe for easements and allowed rights-of-way) shall conform to AWWA Standard C900 or C905, as appropriate for pipe diameter. All pipes shall be hydrostatically proof tested at the factory in conformance with UNI-B-11 standards. In case of conflict between standards specified herein, the requirements of AWWA Standard C900 and C905 shall prevail. Pipe is to be manufactured to ductile iron pipe equivalent outside diameters. The pipe material shall be clean, virgin, National Sanitation Foundation approved, Class 12454-B PVC compound conforming to ASTM resin specification D1784.

Pipe shall have a bell type coupling with a thickened wall section integral with the pipe barrel in accordance with ASTM D3139. Elastomeric seals shall meet ASTM F477. The pipe shall be designed to pass without failure a sustained pressure test of 500 psi in conformance with ASTM D1598 and a quick burst test of 755 psi in conformance with ASTM D1599. Where PVC Casing Pipes can be installed using horizontal directional drilling techniques, equivalently rated fusible PVC pipe may be approved.

PVC Fittings six (6) inches through twelve (12) inches may be used with PVC C900 pipe. Fittings shall be PVC injection molded, made from materials meeting or exceeding the requirements of cell class 12454-B material as defined in ASTM D1784. All PVC fittings must comply with or exceed, AWA C907. All fittings must be designed to the pressure class of the pipe used, with a pressure rating of 150 psi and a 2.5 to 1 factor of safety. Virgin materials only shall be used in the manufacture of PVC pressure fittings. These fittings must have UL-FM approval and shall comply with or exceed all ASTM Standards for PVC fittings. All fittings must have NSF-61 approval. The elastomeric gasket shall comply with the requirements specified in ASTM F477.

3.5.3 Ductile Iron (D.I.P.) Pipe and Fittings

D.I.P. wall thickness and pressure class shall conform to ANSI Specification A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151) with pressure class 350 as a minimum. Pipe shall also be certified by ISO 9000 by an accredited registrar.

Pipe shall be clearly marked with the name of the manufacturer, location of the foundry, pressure rating, thickness or pressure class, nominal pipe diameter, weight of pipe without lining, maximum depth of bury and length.

All pipe furnished by the manufacturer shall be cast and machined at one foundry location to assure quality control and provide satisfactory test data. All ductile iron pipe shall be color coded green by field painting a green stripe, three (3) inches wide, along the crown of the pipe barrel.

All ductile iron pipes and fittings shall be externally coated with a bituminous coating as specified in ANSI A21.51 and be continuous smooth, neither brittle when cold or sticky when exposed to the sun, and be strongly adherent to the fitting. If the pipe is installed in a corrosive soil, then all bolts, nuts, studs and other uncoated parts of joints for underground installation shall be coated with asphalt or coal-tar prior to backfilling.

All ductile iron pipes and fittings shall be Sewer Safe internally lined with an approved amine cured novalac epoxy coating containing at least 20% by volume of ceramic quartz pigment.

Ductile iron fittings shall have a minimum working pressure of 350 psi. Fittings shall conform to ANSI Specifications A21.10 (AWWA C110), A21.11 (AWWA C111), A21.15 (AWWA C115) and/or A21.53 (AWWA C153). Fittings shall also be certified by ISO 9000 by an accredited registrar. Compact fittings shall normally be installed. Long body fittings shall be used where the drawings specifically call for long body fittings, where compact fittings are not available, or at the option of the contractor when the laying length is not controlled by compact fittings patterns. All fittings shall be UL/FM approved and shall conform to NSF Standard 61, as applicable. All fittings furnished by the approved manufacturer shall be cast and machined at one foundry location to assure quality control and provide satisfactory test data. Fittings shall have cast on them the pressure rating, nominal diameter of openings, manufacturer's name, foundry location, plant code and degrees or fraction of the circle. Cast letters and figures shall be on the outside body of the fitting. All ductile iron fittings shall be externally coated and internally lined as specified in this specification.

3.5.4 High Density Polyethylene (HDPE) Pipe and Service Connections

For Horizontal Directional Drilling or Pipe Bursting, HDPE Pipe shall be ductile iron pipe size outside diameter, SDR 11 high performance, high molecular weight, high density polyethylene pipe, and shall conform to ASTM D 1248 (Type III C, Category 5, P34).

Minimum cell classification values shall be 345434C as referenced in ASTM D 3350. All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to insure complete resin compatibility and total product accountability.

Fittings for service connections shall be Inserta-Tee or electro-fusion type fittings only.

3.5.5 Fusible Polyvinyl Chloride (FPVC) Pipe and Service Connections

For Horizontal Directional Drilling or Pipe Bursting, Fusible C-900, C-905, DR-18 FPVC and 1120, SDR-26 FPVC pipe shall be cast iron pipe size outside diameter, conforming to ASTM D3034. All piping shall be made from a PVC compound conforming to cell classification 12454 per ASTM D1784. Pipe shall be extruded with plain ends which shall be square to the pipe and free of any bevel or chamfer.

There shall be no bell or spigot gasket of any kind incorporated into the pipe. Pipe shall be manufactured in standard 40 foot nominal lengths, with other lengths available upon request. For gravity sewer use, pipe shall be green in color. The pipe shall be marked per industry standards. The pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

Fittings for service connections shall be Inserta-Tee or watertight stainless steel saddle type fittings suitable for use on C-900 pipe.

3.5.6 Manholes

3.5.6.1 Manhole Diameter

The minimum manhole inside diameters for gravity sewer lines six (6) inch through sixteen (16) inch shall be four (4) feet; for lines eighteen (18) inches through thirty (30) inches – five (5) feet; for lines thirty six (36) inch through forty eight (48) inch – six (6) feet; and for lines greater than forty eight (48) inches – eight (8) feet. Where the depth of a manhole, (from finished grade to lowest pipe invert), is fifteen (15) feet or greater, the minimum manhole diameter shall be five (5) feet.

3.5.6.2 Precast Concrete Manholes

Precast concrete manholes or calcium aluminate cement concrete manholes used shall conform to all requirements of ASTM Designation C478 at minimum and be provided with "O" ring gasket type joints, conforming to ASTM Designation C443-77, or flexible joint sealant roping of butyl rubber conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B-Butyl Rubber with a minimum cross section of 1 ¼ inches, and shall be:

- (a) constructed using a top section cast monolithically and shaped as an eccentric cone, or for manhole depths five (5) feet or less be a concentric cone, joint systems must match associated riser or base sections; the clear opening for the manhole frame & cover shall not be less than twenty four (24) inches for main sewers six (6) inches through eighteen (18) inches in diameter, and not less than thirty two (32) for main sewers greater than eighteen (18) inches in diameter;
- (b) constructed using riser sections cast monolithically having a minimum lay length of sixteen (16) inches and of joint systems matching associated base and cone sections;

(c) constructed using a base section cast monolithically having a minimum lay length of sixteen (16) inches and a joint system matching associated riser and cone sections;

(d) constructed, where depth permits, using a precast eccentric transition section to reduce base section diameters of six (6) foot or greater, to five (5) foot diameter at finish grade. Such transitions shall not be made less than four (4) vertical feet above the invert bench;

(e) constructed, where manhole depth will not permit a diameter transition section, using a precast flat slab top section with centered thirty two (32) diameter hole for the manhole frame & cover opening;

(f) constructed using precast inverts providing clearance for pipe projecting a minimum of two (2) inch inside the manhole wall, troughs formed and finished to provide a minimum slope of 1.25% from the pipe outlet to the inlets, minimum concrete thickness from the bottom of the lowest invert to the bottom of the base not less than eight (8) inches, invert benches with a uniform 2:1 slope from the high point at the manhole wall to the lip of the invert trough; trough depth from the lip of the invert trough to the invert of the pipe to be 50% of the main pipe diameter; inverts shall be free from depressions, high spots, voids, chips or fractures over one fourth ($\frac{1}{4}$) inch in diameter or depth;

(g) hand-formed inverts, when approved for use, shall meet or exceed the durability, strength, configuration and hydraulic "smoothness" as required for precast inverts. Filler for inverts shall be holed burned brick;

(h) steps, on the vertical or straight wall of four (4) foot and five (5) foot diameter manholes shall be aligned vertically on sixteen (16) inch centers, secured to the wall with a compression fit in tapered holes or cast in place, coated with a copolymer polypropylene plastic coating, reinforced with one-half ($\frac{1}{2}$) inch diameter grade 60 bar with serrated treads and tall end lugs; step pullout strength shall be 2000 lbs. minimum when tested according to ASTM C497; steps shall begin no less than eighteen (18) inches from the manhole rim and end no closer than sixteen (16) inches above the manhole bench;

(i) steps shall not be used on manholes greater than five (5) foot in diameter or where a concentric cone or flat-slab top is the final section;

(j) lifting, devices for handling precast manhole section components shall comply with OSHA Standard 1926.704;

(k) manhole entrance couplings with the entry pipes greater than eighteen (18) inch in diameter shall be fitted with pipe entrance connectors conforming to ASTM C923, and for eighteen (18) inch pipes and smaller to ASTM C-425 using neoprene boot inserts tightened to the pipe using a stainless steel adjustable band, ("A-Loc" or approved equal), rigid cement or synthetic type grout collars are not acceptable as a seal between the manhole and entry pipe in new construction.

3.5.6.3 Fiberglass Manholes

Water tight fiberglass manholes shall be reinforced polyester manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements. Manhole shall be a one piece unit manufactured to meet or exceed all specifications of A.S.T.M. D-3753 latest edition or approved equal.

Fiberglass manholes shall be bedded and fully encased in a Class I gravel envelope from the base to the top of the fiberglass structure to insure lateral support; the thickness of the gravel envelope shall be no less than six (6) inches around the entire circumference of the structure.

(a) Resin: The resins used shall be a commercial grade unsaturated polyester resin or other suitable polyester or vinyl ester resin.

(b) Reinforcing Materials: The reinforcing materials shall be commercial Grade "E" type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

(c) Interior Surfacing Material: The inner surface exposed to the chemical environment shall be a resin-rich layer of 0.010 to 0.020 inch thick. The inner surface layer exposed to the corrosive environment shall be followed with a minimum of two passes of chopped roving of minimum length 0.5 inch (13 mm) to maximum length of 2.0 inch (50.8 mm) and shall be applied uniformly to an equivalent weight of 3 oz/ft. Each pass of chopped roving shall be well rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 inch (2.5 mm).

(d) Wall Construction Procedure: After the inner layer has been applied the manhole wall shall be constructed with chop and continuous strand filament wound manufacturing process, which insures continuous reinforcement and uniform strength and composition. The cone section, if produced separately, shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit. Seams shall be fiber-glassed on the inside and the outside using the same glass-resin jointing procedure. Field joints shall not be acceptable by anyone other than the manufacturer or approved equal.

(e) Exterior Surface: For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added to a minimum thickness 0.125 inches.

(f) Stub-outs and Connections: Upon request stub-outs may be installed. Installation of SDR, PVC, or sewer pipe must be performed by sanding, priming, and using resin fiber-reinforce hand lay-up. The resin and fiberglass shall be the same type and grade as used in the fabrication of the fiberglass manhole. Inserta-Tee fittings may be requested and installed per manufacturer's instructions. Kor-N-Seal boots may be installed by the manhole manufacturer using fiberglass reinforced pipe stub-outs for the Kor-N-Seal boot sealing surface.

(g) Manhole Bottom: Fiberglass manholes will be required to have resin fiber-reinforced bottom. Deeper manholes may require a minimum of two fiberglass channel stiffening ribs. All fiberglass manholes manufactured with a fiberglass bottom will have minimum three (3) inch wide anti-flotation rings as required based on the depth of the manhole, the weight of the gravel backfill and the groundwater uplift forces anticipated at the site. The manhole bottom shall be a minimum of one-half ($\frac{1}{2}$) inch thick.

(h) Fiberglass enclosed invert and bench area: A fiberglass enclosed invert and bench area shall be installed in the manhole by the manufacturer. The invert will be formed using a non-corrosive material and completely enclosed in a minimum one-fourth ($\frac{1}{4}$) inch layer of fiberglass chop.

(i) Height Adjustment: Fiberglass manholes must have the ability to be height adjustable with the use of a height adjustment ring. Height adjustment can be made as a field operation without the use of uncured resins or fiberglass lay-ups. Fiberglass manholes must maintain all load and soundness characteristics required by ASTM D3753 after height adjustment has occurred.

(j) Fillers and Additives: Fillers, when used, shall be inert to the environment and manhole construction. Sand shall not be accepted as approved filler. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific ASTM D-3753 standard. The resulting reinforced-plastic material must meet the requirements of this specification.

(k) Manufacture: Manhole cylinders, man-way reducers, and connectors shall be produced from fiberglass-reinforced polyester resin using a combination of chop and continuous filament wound process.

(l) Interior Access: All manholes shall be designed so that a ladder or step system can be supported by the installed manhole.

(m) Man-way Reducer: Man-way reducers will be concentric with respect to the larger portion of the manhole diameters through 60 inches. Larger manholes may have concentric or eccentric man-way reducer openings.

(n) Cover and Ring Support: The manhole shall provide an area from which a grade ring or brick can be installed to accept a typical metal ring and cover and have the strength to support a traffic load without damage to the manhole.

(o) Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 0.5 inch in diameter, delamination or fiber show.

(p) Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, and blisters larger than 0.5 inch in diameter, and wrinkles of 0.125 inch or greater in depth. Surface pits shall be permitted if they are less than 0.75 inch in diameter and less than 0.0625 inches deep.

Voids that cannot be broken with finger pressure and are entirely below the resin surface shall be permitted if they are less than 0.5 inch in diameter and less than 0.0625 inch thick.

(q) Wall Thickness: Fiberglass manholes forty eight (48) inch in diameter and up to twenty (20) feet in depth will have a minimum wall thickness of .3125 inches. Fiberglass manholes forty eight (48) inch in diameter and twenty (20) feet to thirty (30) feet in depth will have a minimum wall thickness of .5 inches.

(r) Repairs: Any manhole repairs are subject to meet all requirements of this specification.

(s) Manhole Length: Manhole lengths shall be in six (6) inch increments +/- two (2) inches.

(t) Diameter Tolerance: Tolerance of inside diameter shall be +/- 1% of required manhole diameter.

(u) Load Rating: The complete manhole shall have a minimum dynamic-load rating of 16,000 lbs. when tested in accordance with ASTM 3753 8.4 (note 1). To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 lbs. and shall not deflect vertically downward more than 0.25 inch at the point of load application when loaded to 24,000 lbs.

(v) Stiffness: The manhole cylinder shall have the minimum pipe-stiffness values shown in the table below when tested in accordance with A.S.T.M. 3753 8.5 (note 1).

**Figure GS-3
Pipe-Stiffness Table**

LENGTH (FT)	F/AY (PSI)
3.0 to 6.5	0.75
7.0 to 12.5	1.26
13.0 to 20.5	2.01

(w) Soundness: In order to determine soundness, the manufacturer shall apply an air or water pressure test to the manhole test sample. Test pressure shall not be less than 3 psig or greater than 5 psig. While holding at the established pressure, inspect the entire manhole for leaks. Any leakage through the laminate is cause for failure of the test. Refer to ASTM 3753 8.6.

(x) Chemical Resistance: The fiberglass manhole and all related components shall be fabricated from corrosion proof material suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection system.

(y) PHYSICAL PROPERTIES:

	Hoop	Axial
Tensile Strength (PSI)	18,000	5,000
Tensile Modulus (PSI)	600,000	700,000
Flexural Strength (PSI)	26,000	4,500
Flexural Modulus (PSI)	1,400,000	700,000
Compressive (PSI)	18,000	10,000

(z) TEST METHODS/QC/CERTIFICATION: All tests shall be performed as specified in ASTM 3753 latest edition, section 8. Test method D-790 (see note 5) and test method D-695; each completed manhole shall be examined by the manufacturer for dimensional requirements, hardness, and workmanship. All required A.S.T.M. 3753 testing shall be completed and records of all testing shall be kept and copies of test records shall be presented to customer upon formal written request within a reasonable time period; and as a basis of acceptance the Manufacturer shall provide an independent certification which consists of a copy of the manufacturer's test report and accompanied by a copy of the test results stating the manhole has been sampled, tested, and inspected in accordance with the provisions of this specification and meets all requirements.

3.5.6.4 Manhole Frames and Covers

Manhole frames and covers shall be Gray Cast Iron conforming to specification ASTM-A48 Class 35B. Castings shall be of uniform quality, and free from blowholes, porosity, hard spots, shrinkage distortion and other defects. Frames and covers shall be smooth, well-cleaned by shot blasting and shall remain unpainted. All castings shall be manufactured true to pattern, and component parts shall fit together in a satisfactory manner. The frame and cover shall be designed to withstand an AASHTO H-20 wheel loading. The frame and cover shall have an "O" Ring type rubber seal or neoprene gasket designed to eliminate or significantly reduce surface water infiltration, have two non-penetrating pick-holes in the cover and four one (1) inch diameter anchor holes in the frame flange. The cover shall read "Sanitary Sewer"

(a) manhole frames and covers on four (4) foot diameter manholes shall have a minimum inside opening diameter of not less than twenty three (23) inches and no more than twenty four (24) inches and considered a standard twenty four (24) inch frame & cover;

- (b) manhole frames and covers on five (5) foot diameter manholes and greater shall have a minimum inside opening diameter of not less than thirty (30) inches and not more than of thirty one (31) inches and considered a standard thirty two (32) inch frame & cover;
- (c) manhole frames and covers within easements and in areas where security is an issue shall be equipped with manhole locking devices or bolt down covers.

3.6 INSTALLATION OF SEWER MAINS AND APPURTENANCES

The contractor shall install gravity sewer systems in accordance with the installation specifications detailed in this section. All references to industry standards (ASTM, ANSI, AWWA, etc.) shall be to the latest revision unless stated otherwise.

3.6.1 Gravity Sewer Main Depth

Gravity sewer mains shall be designed meeting minimum depth requirements of thirty six (36) inches as measured from finished grade to pipe crown. This depth is based on the minimum height of standard precast manhole sections commonly available; however, where manholes are made of fiberglass or other approved materials where manhole depths can be manufactured to specified heights, this depth restriction may be waived and a minimum depth of thirty (30) inches approved.

Gravity sewer mains with service laterals shall not be constructed at any depth greater than fifteen (15) feet as measured from finished grade to pipe crown.

Gravity sewer mains without service laterals shall not be constructed at any depth greater than twenty (20) feet as measured from the finished grade to pipe invert. Where such deep lines must be constructed, a gravity sewer high-line with services connecting directly into the deep manholes will be allowed. Such high-lines must be off-set at least ten (10) foot laterally from the deep line. Major sanitary sewer transmission mains eighteen (18) inch diameter and greater may be excepted from depth restrictions upon approval by the JWSC.

3.6.2 Gravity Sewer Main Location and Alignment

Gravity sewer mains shall be designed for installation on the centerline of roadways as much as possible where landscaping, trees or other obstruction to manhole access is anticipated or probable.

At no time, shall gravity sewer mains or manholes be less than ten (10) feet inside of road rights-of-way lines. Gravity sewer manholes may not be designed or constructed to be less than four (4) feet off roadway curb & gutters. No gravity sewer manholes may be designed or constructed to lie within ditch lines.

Gravity sewer mains shall be installed with a straight alignment between manholes.

Gravity sewer mains up to twelve (12) feet in depth that are not in public rights-of-way shall be centered in a twenty (20) foot wide exclusive easement dedicated to the JWSC. The JWSC retains the right to require additional or less easement width where maintenance or access circumstances warrant.

Gravity sewer mains greater than twelve (12) feet in depth that are not in public rights-of-way shall be centered in a thirty (30) foot wide exclusive easement dedicated to the JWSC. The JWSC retains the right to require additional or less easement width where maintenance or access circumstances warrant.

All gravity sewer main easements shall be accessible and unobstructed to JWSC maintenance vehicle traffic with a stabilized twelve (12) foot wide access with a minimum Load Bearing Ratio (LBR) of 30. The access must be adequately graded for service vehicle use and provided with adequate drainage. The access travel area may, at minimum, be composed of a sturdy grassed surface to prevent erosion from storm runoff and maintainable by mowers or bush hogs.

Easements interrupted by wetlands, streams or ditches that would preclude the travel of maintenance equipment from end to end must be provided with auxiliary lateral ingress/egress easements to permit access to the sewer line easement so that each line segment and manhole is accessible to maintenance service vehicles. A truck turnaround area should be provided at the intersection of all ingress/egress and sanitary sewer line easements.

A horizontal distance of six (6) feet minimum shall be maintained from all gravity sewer mains or manholes to drainage structures, telephone duct banks, electrical transformers, signal relays, power poles and other structures in the right-of-way as well as any other parallel underground utilities. Gravity sewer mains crossing other underground utilities, (with the exception of water mains), shall have a minimum vertical separation of six (6) inches. All distances shall be measured from the outside edge of the pipes. Exceptions must be approved by JWSC.

Gravity sewer mains located adjacent to storm water retention, ponds, lakes and water courses shall be designed with sufficient easement and spacing from bank crowns. The potential for side slope collapse shall be based on 3 to 1 side slopes and the pipe's depth of bury. The JWSC reserves the right to require casing pipe in such situations where inadequate spacing can be demonstrated.

3.6.3 Gravity Sewer and Water Main Separation Requirements

There should be no physical connections between a public or private potable water supply system and a sanitary sewer, or appurtenances which would permit the passage of any sewage or polluted water into the potable supply. No water pipes shall pass through or come in contact with any part of a sewer manhole.

Sanitary sewers shall be laid at least ten (10) feet horizontally from an existing or proposed water main. On a case by case basis, when this separation is not possible or practical, a deviation may be allowed if the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so that the bottom of the water main is at least eighteen (18) inches above the top of the sanitary sewer.

At crossings, pipe joints shall be as far as possible and equidistant from the point of crossing. Water main preferred on top. Separation shall be measured from the outside edge of the pipe to the outside edge of the pipe. A full length of water main pipe must be centered at the crossing. Water pipe joints shall be arranged so that all water main joints are at least six (6) feet from all gravity sewer line joints. Where a water main must cross under a gravity sanitary sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

3.6.4 Encasements and Casing and Aerial Crossings

Reaches of gravity sewer located in easements that cross wetlands, which are to be restored as wetlands, shall be sub-aqueous, shall be encased in corrosion resistant coated steel or Fusible PVC casing and treated for leakage. Those runs which include manholes, located across wetlands, shall be accessible to maintenance vehicles. A stabilized access road, twelve (12) foot wide with a minimum Load Bearing Ratio (LBR) of 30 shall be provided and indicated on the Record Drawings for easements requiring multiple manholes. The access road should be designed to provide for adequate drainage and to prevent erosion from storm runoff. A truck turnaround area should be provided at the end of all access roads.

Reaches of gravity sewer located in easements that cross under streams or within three (3) vertical feet of the bottom of canals, ponds, lakes or ditches that may be considered Waters of the State or otherwise environmentally sensitive due to local recreational use, shall be sub-aqueous, shall be encased in a corrosion resistant coated steel or Fusible PVC casing and tested for leakage.

Casing ends shall extend a minimum of twenty five (25) feet beyond stream banks and be electronically marked using an approved method or signed to show the casing end points. Such crossings shall be limited in length as much as possible and no reach of gravity sewer across such water body shall exceed four hundred (400) linear feet between manholes.

Reaches of gravity sewer crossing public rights-of-way on State, County and City Primary Roads or railroads shall be encased in corrosion resistant coated steel or Fusible PVC casing (if allowed by the Railroad or Department of Transportation Authority) and tested for leakage. Casing ends shall extend a minimum of ten (10) feet beyond the furthest edge of pavement, curb and gutter, storm drain systems or sidewalks, whichever is greater, and be electronically marked using an approved method to allow the positive identification of casing end points. Such crossings shall be limited in length as much as possible and no reach of gravity sewer shall exceed four hundred (400) linear feet between manholes.

Reaches of gravity sewer crossing streams, ditches and canals where sub-aqueous crossings are not practical by system design due to grade considerations may be aerial crossings. Where stream width allows, one pipe joint of Sewer Safe DIP shall be used with precast concrete pipe piers having saddle type top sections and anchored galvanized pipe straps. Such piers shall be set a minimum of ten (1) feet beyond the existing stream banks with bases set a minimum of two (2) feet below the existing stream bottom. Where the stream width dictates that more than one joint of Sewer Safe DIP be used, the crossing pipe shall be Sewer Safe DIP flanged joint with piers set adjacent to each pipe joint and end piers set and as specified for single joint crossings. Attachment to stream bridges and or other stream crossing structures will not be permitted.

3.6.5 Gravity Main Stub-outs

Gravity sewer main stub-outs shall be provided to all undeveloped property and/or future phases of the project in accordance with the sewer master plan for the collection system service area.

Where gravity stub-outs are required, they shall be extended to within four (4) feet of the property line, plat line or phase line and shall extend a minimum of ten (10) feet past the edge of pavement or a distance of 1.5 times the sewer depth whichever is greater. The stub-out shall be terminated with a "no-invert" manhole with the effluent line plugged by a mechanical plumber's plug. **(See JWSC Standard Detail)**

Where gravity sewer extensions are made where there is no reasonable definition of undeveloped or un-subdivided property to be served with a stub-out, as specified above, the end of line manhole shall be set so as not to accept any wastewater contribution from the installed system and be constructed without an invert or any influent line wall core or hole.

3.6.6 Sewer Services

Single gravity services shall be provided to each lot or parcel provided that adequate and accessible utility corridors are also provided for maintenance.

Each residential lot shall have only one connection point to the public sanitary sewer system main.

Where commercial developments require multiple connection points to a sanitary sewer main, an internal privately owned piping system shall be installed that will drain to the public main at only one connection point.

Where services must be constructed through private property to access the public sanitary sewer system, it is the property owner's responsibility to secure a private sewer utility easement with the owner of the property through which the line will be constructed and provide documentation of such filed easement with the JWSC.

Gravity sewer services shall be at least one nominal diameter less than the size of the gravity main to which it is connected. Where the size of the service must be the same size of the main a sanitary sewer manhole shall be installed. No sanitary sewer service that is larger than the diameter of the serving sewer main shall be permitted unless specific plans by the JWSC to upgrade the sewer main allow a temporary connection to be approved.

Gravity sewer services shall be a minimum of four (4) inches in diameter where serving a single unit or six (6) inches in diameter where serving two lots with a common connection to the main. All service laterals shall be constructed from the main to the lot to be served at a one-eighth (1/8) inch per foot slope (1%).

Gravity sewer service stub-outs shall be marked with a two (2) inch diameter pressure treated pine post. The bottom of the post shall be set two (2) to three (3) inches above the top and directly over the end of the stub-out and protrude approximately two (2) feet above finished grade. The post shall be painted green.

A service shall be designed to connect to the gravity main with an inline wye fitting rotated 45 degrees up. The invert elevation of the service at the wye connection shall be at or above the crown of the mainline pipe and the sewer flow shall enter the main through the wye positioned at 10 o'clock or 2 o'clock on the main. No service connections made at the 12 o'clock position on a main will be acceptable (**See JWSC Standard Details**).

Single/Multiple Family Residential Gravity Sewer Services:

(a) Where a service is to serve a single lot or a lot on which an indivisible duplex, triplex or quadraplex unit is being constructed, the service shall be installed at the center of the lot and front the property being served. Such services shall be perpendicular to the main. All service stub-outs shall be properly marked as noted above and shall have a clean-out installed within one foot of the property or easement line and within private property, to separate private from public responsibility upon connection. The responsibility for the clean-out shall be the owners (**See JWSC Standard Details**).

(b) Where adjacent residential properties can share a common service line the service wye that splits the discharge between the users must be constructed completely within the public rights-of-way corridor or easement using a six by four (6X4) inch double-wye fitting with the four (4) inch branching service lines from the wye ending at a point at the property line that will not conflict with other utility components such as transformers, phone pedestals, water meters, light poles, etc. Each four (4) inch branch stub-out shall be properly marked as noted in this Section and shall have a clean-out installed within one foot of the property or easement line and within private property, to separate private from public responsibility upon connection. The responsibility for the clean-out shall be the owners. Such double services may be approved for light commercial properties upon approval of the JWSC (**See JWSC Standard Details**).

Double services, as described above may be applicable for certain commercial properties upon approval by the JWSC.

Services shall be limited to 60' maximum length from either the sewer main or the manhole to the property line.

All services shall run perpendicular to the gravity sewer main line; no services shall be constructed parallel to the rights-of-way or easement line or run diagonally across rights-of-ways or easements with the exception of cul-de-sacs or where sharp curves in roadways or easements occur..

Services shall be marked with an "S" inscribed in the curb face, directly over the service line, and painted green.

Services shall terminate no less than thirty (30) inch deep and no greater than sixty (60) inch deep at the property line and where not expected to be in conflict with other crossing underground utilities.

Services that cross under storm drain structures or ditches, and do not have a minimum one and one half (1 1/2) foot vertical clearance between the invert of the storm drain pipe or the ditch bottom, shall be constructed with one joint of sewer safe D.I.P. centered under the storm pipe or ditch.

Private clean-outs shall not be installed in the Rights-of-way or easements. The responsibility for the protection and repair of clean-out shall be the owners.

Service connections are not permitted on trunk sewers larger than 15" in diameter.

Service Connections to manholes are allowed as follows:

- (a) Inline manhole connections are limited to 2 services, one from each side of the rights-of-way or easement and installed perpendicular to the Rights-of-Way or easement.
- (b) Terminal manholes located in residential cul-de-sacs are allowed 3 service connections. The invert of each service connection shall be a minimum of five (5) inches above the invert of the manholes effluent (outgoing) main line.

Services shall not be connected to main line stub-outs without a manhole.

3.6.7 Sewer Manholes

3.6.7.1 Location

Manholes shall be installed at the end of each main and at all changes in grade, pipe size, pipe material, or alignment and at all pipe intersections. The only recognized exception shall be where pipe material changes are allowed on a particular reach of main by this standard (i.e. D.I.P installed under storm drains, water mains, etc.).

Manholes where pipe diameter changes occur shall establish invert elevations by matching pipe crowns. Where the vertical difference in pipe inverts, caused by matching crowns occurs, are less than 1.5 feet in 4' diameter manholes and 2 feet in 5' or larger manholes between influent and effluent lines, transitional flow slides may be used so long as they do not interfere with the smooth flow through the primary manhole trough or other influent line flows.

Manholes shall be located on the centerline of roadways or out of the wheel lane and a minimum of four (4) feet from the edge of the manhole to the curb and gutter; but never installed in ditch lines.

Manholes shall not be installed in the flow line of inverted crown roads or within the design high water limits of gutters, swales, or retention/detention areas.

Manholes located within easements shall have the ring and cover set six (6) inches to eight (8) inches above final grade.

3.6.7.2 Spacing

The maximum spacing of manholes shall be four hundred (400) feet for sewer mains less than or equal to fifteen (15) inches diameter and five hundred (500) feet for sewer mains greater than fifteen (15) inches diameter. A gravity main exceeding the maximum length may be allowed where a practical and sufficient reason can be demonstrated; however, such additional length shall not exceed the allowed maximum distance by more than fifty (50) feet.

3.6.7.3 Clearance Requirements

Manholes shall have three (3) feet minimum clearance from outside edge to outside edge of other utility components, such as storm drains and storm drain boxes, utility poles, transformers, phone pedestals and cable systems.

3.6.7.4 Depth

The design depth for all manholes is to be at no less than thirty six (36) inches from the top of the manhole to the pipe crown.

3.6.7.5 Drop Connections

Outside and Inside drop connections are only allowed within limited boundary subdivision developments to be dedicated as public infrastructure, where the potential for gravity system extensions from the manhole to adjacent properties is blocked or unanticipated by the sewer master plan, and the main line pipe size is eight (8) inches or greater. Where outside drops are acceptable, they shall be required where the vertical difference between inverts is greater than one and one-half (1 ½) feet in four (4) foot diameter manholes or two (2) feet in manholes greater than four (4) feet in diameter (**See JWSC Standard Details**). Inside drops will only be approved where connections are being made to an existing system where depth restraints preclude the practical installation of an outside drop.

Outside drops, where the vertical distance of the drop is ten (10) feet or less, shall be constructed of SDR-35 PVC pipe, bedded and backfilled along with the entire manhole structure to within ten (10) inches of the final grade with Class I material; where the vertical distance of the drop is greater than ten (10) feet, the drop shall be encased in a concrete column of a minimum two (2) inches thickness around all pipe walls, and poured so as to provide a concrete base as a foundation for the drop bottom connection; the entire concrete structure shall be tied to the manhole wall with rebar studs for the full depth of the drop.

Inside drops, where approved, must enter the manhole with a PVC tee fitting with a gasketed cap cut to one-half (½) of the host pipe diameter attached to the branch following the slope of the pipe reach being drained, the down leg placed closely against the manhole wall fastened with (316) stainless steel anchor bolts and bands on two (2) foot centers, an angled fitting and invert trough at the base to direct the flow smoothly into the existing flow line; all PVC piping and fittings shall be SDR-35 (**See JWSC Standard Details**).

3.6.7.6 Grade Rings

Grade rings, where necessary to serve as spacers between the top cone of the manholes and the base of the manhole cover frame to bring the manhole design or finish grade, shall be hard rubber or approved equal to absorb vibration in paved areas and high density polyethylene or cement rings in off road applications. Adjustments using clay or cement brick are not acceptable.

On new construction, an adjustment using metal riser rings to extend the manhole cover frame to grade is not permitted. No adjustment using grade rings between the top cone section and the manhole cover frame shall exceed sixteen (16) inches.

3.6.7.7 Corrosion Protection

Manhole corrosion protection shall be provided for manholes in accordance with the following schedule based on detention time of sewer flow from the uppermost region of the contributing pipe reach using an average velocity of two (2) feet/sec.

Vapor H2S	Corrosion Risk Level	Detention Time	Corrosion Protection
0-10 PPM	No or Low Risk	<2 Hours	None
11-50 PPM	Moderate Risk	2 - 4 Hours	Coal Tar Epoxies
>50 PPM	High Risk	>4 Hours	Calcium Aluminates Epoxy Coatings Approved Lining Systems
FM Discharge Manhole	High Risk	N.A.	Calcium Aluminates Epoxy Coatings Approved Lining Systems

(a) Corrosion protection for *High Risk* manholes shall be hydrogen sulfide resistant cementitious products containing calcium aluminates applied at a minimum of one-half (½) inch to three-fourths (¾) inch in thickness or epoxy coatings applied a minimum of 150 mil thickness onto all interior manhole surfaces, excluding the trough, after proper substrate preparation; or precast manholes manufactured of calcium aluminate cement concrete; or manholes manufactured of fiberglass. Alternatives that provide equal or better protection may be approved.

(b) Any manholes receiving the discharge from upstream lift stations shall be considered a *High Risk* manhole and the 2nd and 3rd manholes downstream shall be considered *Moderate Risk* manholes and protected per this standard.

3.6.8 Pipe Trench Construction, Bedding, Backfill and Workmanship

At no time shall the bedding, haunching, initial backfill or final backfill be less than, or in contradiction to the pipe manufactures recommendations for the pipe materials being used.

3.6.8.1 Rigid Pipe

Rigid Pipe Materials (DIP) shall be laid in a Type 2 (flat bottomed) trench with a pipe bedding of Class I gravel or naturally occurring clean compacted sand, as necessary to provide a firm unyielding pipe foundation; or where the natural trench foundation is weak, on a Class I (#57 or #64 stone) gravel of sufficient depth to provide a firm and unyielding foundation, (in both cases, the compacted bedding shall extend across the entire width of the trench to undisturbed trench walls on either side of the pipe); initial backfill (from bedding to pipe crown) shall be hand tamped gravel or sand material free from cinders, ashes, refuse, vegetable, or organic material, boulders, rocks, or stones, frozen soil or other materials that, in the opinion of the JWSC is unsuitable. Final backfill in non-traffic areas, (from pipe crown to final grade), shall be Class IV material or better and free of boulders, rocks and stones greater than twelve (12) inches in their greatest dimension, tree trunks or limbs, brush from clearing, refuse or trash, frozen soil or any organic materials which may decompose and create voids. Final backfill in traffic areas shall be Class III material mechanically compacted in two (2) foot lifts to 95% modified proctor to within ten (10) inches of final grade, eight (8) inches of crusher run gravel compacted to 95% modified proctor, and two (2) inches of Type III asphalt pavement to final grade or other pavement type or dimension as required by the road authority on the encroachment permit.

3.6.8.2 Flexible Pipe

Flexible Pipe Materials (PVC, HDPE) shall be laid in a Type 2 trench with Class I gravel or naturally occurring clean compacted sand bedding material as necessary to provide a firm unyielding pipe foundation; or, where the naturally existing foundation is weak, on a Class I gravel bedding of sufficient depth to provide a firm and unyielding foundation; initial backfill (from bedding to crown of the pipe) shall be Class I material placed with shovel slicing (haunching) or clean naturally occurring hand-tamped sand along the sides of the pipe to insure firm side support and that no voids exist along the pipe barrel or between the pipe barrel and the undisturbed trench walls. Final backfill for traffic areas and non-traffic areas shall be as specified for rigid pipe materials.

3.6.8.3 Unsuitable Materials

Where rock or other unsuitable material is encountered at pipe grade, such rock or unsuitable material shall be removed to a minimum of six (6) inches below the proposed pipe grade line, refilled with Class I material to the correct pipe grade to protect the pipe from point loadings from below and provide base material for adjustment to grade and trench drainage; initial backfill and final backfill shall follow as per standards herein delineated.

3.6.9 Gravity Sewer System Testing and Inspection

All gravity sanitary sewer lines up to thirty (30) inches in diameter, to include connected services and/or main stub-outs shall be low pressure air tested in accordance with ASTM F1417 and conducted in substantial conformance with the procedures below.

- a. air testing shall be performed as soon as possible after completing a reasonable length of gravity sewer installation, and before scheduling Preliminary Record Drawing Line Televising;
- b. the system installer shall furnish all equipment, material, and personnel to conduct the test using low pressure air;
- c. the test equipment shall be approved and the test conducted in the presence of a JWSC Construction Inspector;
- d. testing shall be conducted after backfilling has been completed but before finish grading or surface improvements;
- e. all wye's, tees, and lateral stubs or other fittings shall be suitably capped to withstand the internal test pressures;
- f. after a manhole-to-manhole section of line has been cleaned, it shall be plugged at each manhole with pneumatic plugs inflated to 25 psi internal pressure; plug bracing may be used as necessary to keep plugs from being blown out of lines;
- g. one of the test plugs shall have two factory equipped hole connections in addition to the hose connection used to inflate the plug. One connection shall be used to continuously monitor the rising air pressure in the sealed line. The other connection shall be used only for introducing the low pressure air into the sealed line;
- h. three and one-half (3 ½) inch diameter, 0-30 psi air gauge shall be supplied for reading the internal pressure of the line being tested. Calibrations from the 0-10 psi range shall be in tenths;
- i. low pressure air shall be introduced into the sealed line until the internal pressure reaches 3.5 psi greater than the average back pressure of any ground water that may be above the pipe, but not greater than 9.0 psi. At least two (2) minutes shall be allowed for the air pressure to stabilize.

After this period the hose used to introduce the pressure shall be disconnected from the air source in such a manner as to retain the pressure in the sealed line and the compressor shut down;

- j. the portion of the line being tested shall be accepted if it does not lose air at a rate greater than 0.0015 cfm per square foot of internal pipe surface when tested at an average pressure between 3.5 and 4.0 psi greater than any back pressure exerted by ground water that may be over the pipe at the time of the test;
- k. time requirements for pressure drop of 1.0 psi or 0.5 psi (3.5 to 2.5 or 3.5-3.0 psi greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameter in the tables provided in the ASTM Standards;
- l. where high ground water is known to exist, the height in feet of ground water above the invert of the sewer shall be divided by 2.31 and added to 3.5 psi to establish the amount of pressure to be used for the test;
- m. if, the line fails to meet the requirements of the test, the source of leakage shall be identified and corrected and the line retested.

3.6.9.1 Low Pressure Air Test

Gravity sewer mains greater than thirty (30) diameter shall be low pressure air tested at the joints and/or noted defects using equipment capable of isolating each joint or defect from the rest of the pipe. Testing pressures and passing values shall be the same as cited above.

3.6.9.2 Infiltration Test

Where gravity sewer lines cannot be low pressure air tested in accordance with this Standard, the system shall be subjected to an infiltration test to establish leakage less than 100 gallons per inch per day per mile (gal/in/day/mile) using a V-notch weir; however, where ground water conditions are not favorable for testing, (ground water levels less than eight (8) feet over the pipe invert for any individual line segment), the end of the line to be checked shall be plugged at the downstream manhole, the upstream manhole partially filled to place a 3.5 psi head on the subject line at the lowest end, and the change in water depth noted during the test period converted to a volume; such volume and test time duration shall be compared against the 100 gal/in/day/mile Standard.

3.6.9.3 Vacuum Test

All sanitary sewer manholes shall be vacuum tested in accordance with ASTM C 1244-93 and conducted in substantial conformance with the following procedures:

- a. The entire manhole structure, to include the joint between the cast iron frame & cover and the top cone or adjustment ring, shall be tested as a unit;
- b. All lift holes shall be plugged
- c. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole
- d. Place vacuum test head on the top of the manhole structure, setting the sealing face so that the joint between the manhole frame & cover and the main structure is included in the area to be tested;
- e. Draw a vacuum of ten (10) inches of mercury on the manhole, shut the valve on the vacuum line of the test head and turn off the vacuum pump;
- f. Measure the time in seconds that it takes for the vacuum to drop to nine (9) inches of mercury;
- g. Compare the time of the pressure drop from ten (10) inches to nine (9) inches of mercury with the allowable time value for the manhole diameter and depth as shown on the table in the Section appendix;
- h. If the manhole fails the initial test, necessary repairs shall be made by an approved method and the manhole retested until a satisfactory test is obtained.

3.6.9.4 Visual Inspection

All sanitary sewer mains will be visually inspected using color CCTV provided equipment by a PACP (Pipeline Assessment Certification Program) certified operator using PACP certified software. This service will be provided by the JWSC upon demonstration by the installer that the sewer lines and manholes have passed air and vacuum tests, the lines have been hydraulically cleaned using a combination cleaner and presentation of a Preliminary Record Drawing of the sanitary sewer system as installed.

The CCTV equipment shall include inclinometer capabilities that capture the line grade values in percent as the camera proceeds along the line and also provides a chart showing the average line grade from pipe start to pipe end for verification of Record Drawing slopes. The system installer is responsible for providing adequate trafficable access to the system components to perform this work.

A CCTV re-inspection of any and all defects found in mains during any previous test shall be required prior to acceptance.

3.6.9.5 Deflection Testing

Deflection testing shall be performed on any flexible pipe reach installation where CCTV inspection observations indicate that the pipe may be deflected or ovalized in any dimension beyond allowable values. Where required, deflection testing shall be performed in substantial compliance with the following procedures:

- a. Deflection testing shall be accomplished by pulling a five (5%) mandrel through the line if it has been installed for less than thirty days, or a seven and one-half (7 ½ %) mandrel on any line which has been installed longer than thirty days.
- b. An approved mandrel, proving ring, pulling ropes and cables shall be provided by the installer for testing PVC pipe.
- c. The mandrel shall be hand pulled through the pipe using no wenches or other mechanical devices except a pulley at the manhole invert. The pulley allows the mandrel to be pulled from ground level rather than from inside the manhole.
- d. If, at any point in the pipe one (1) man is unable to hand pull the mandrel through the pipe, then the pipe will be deemed unacceptable.
- e. The failed pipe shall be repaired by the installer, the mandrel re-pulled and the line re-televised at the Contractor's expense.

**APPENDIX 3A
ACCEPTABLE MANUFACTURERS**

APPENDIX 3A

GRAVITY SEWER SYSTEMS
ACCEPTABLE MANUFACTURERS

PARAGRAPH	PRODUCT	MANUFACTURERS
3.5	Material Specifications	
3.5.2	<i>PVC 1120, Class 160, SDR 26 PVC 1120, Pressure Class (PC) 235 SDR 26 Gasketed Fittings</i>	Vulcan Plastics JM Eagle Multi-Fittings GPK Products Plastic Trends
	<i>PVC 1120, Class 118, SDR 35 SDR 35 Gasketed Fittings</i>	Vulcan Plastics JM Eagle Multi-Fittings GPK Products Plastic Trends
	<i>No Hub Fittings</i>	Fernco LDR
	<i>PVC 1120, Class 150, DR 18 DR 18 Sewer Safe Mechanical Joint Fittings</i>	Vulcan Plastics JM Eagle Star Pipe Sigma Corp.
3.5.3	<i>Ductile Iron Pipe Ductile Iron Pipe Sewer Safe Mechanical Joint Fittings</i>	Griffin Pipe US Pipe Star Pipe Sigma Corp.
3.5.4	<i>High Density Polyethylene (HDPE) Pipe</i>	Performance Pipe JM Eagle Lamson & Sessions
3.5.5	<i>Fusible Polyvinyl Chloride (PVC) Pipe Sewer Safe Coupling</i>	Underground Solutions Inc. (ONLY MANUFACTURE) HyMax Star Pipe Sigma Corp.
3.5.6	Manholes	
3.5.6.2	<i>Precast Concrete Manholes</i>	Hanson Pipe and Precast MegaCast MST Concrete Products
3.5.6.3	<i>Fiberglass Manholes</i>	L.F. Manufacturing, Inc.
3.5.6.4	<i>Manhole Frame and Covers</i>	U.S. Foundry and Manufacturing
3.6.7	Sewer Manholes	
3.6.7.6	<i>Grade Rings</i>	Sealing Systems, Inc. Custom Concrete
3.6.7.7	<i>Corrosion Protection</i>	
	<i>Moderate Risk</i>	Raven Epoxy Sewer Shield Parsonpoxy Hydro-Pox Epoxy

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3.6.7	Sewer Manholes	
	<i>High Risk</i>	Spectra Shield SewperCoat Green Monster
	<i>Significant Risk</i>	SewperCoat Green Monster

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SECTION 4
SANITARY SEWER LIFT STATIONS AND FORCE MAINS

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SECTION 4

SANITARY SEWER LIFT STATIONS AND FORCEMAINS

4.1 GENERAL

This section provides the minimum guidelines for the design of wastewater lift stations and their associated forcemains that are considered an integral component of the facility's pumping system. The method of design and/or construction shall be according to, these Design and Construction Standards and Specifications and the following:

*Recommended Standards for Sewage Works (Ten State Standards)
Latest Edition*

*Georgia Environmental Protection Division State of Georgia Regulations
for Water and Sewerage Works, Latest Edition*

Applicable Federal, State and Local Requirements

In the event of conflicts among the various sources cited above, the most stringent criteria shall take precedence.

4.2 DESIGN FLOWS

Each system component shall be designed to meet certain flow requirements. The various flow requirements are described below.

4.2.1 Daily Average Dry Weather Flow (ADWF)

Daily Average Dry Weather Flow (ADWF) shall be 300 gallons per day per Residential Equivalent Unit (REU) or 115 gallons per day per capita. The basis for one (REU) shall be a single-family unit **occupied by an average of 2.6 persons**. Where sewer service beyond the basis of the established REU is required, the Sewage Flow Table shown below (Adapted from the Georgia Environmental Division Large Community Design Guidance Document, Pages 8 & 9, Appendix A) shall be used.

ADWF estimates for existing facilities that are scheduled for **rehabilitation** shall be made using data obtained from flow monitoring the existing system over a period of not less than seven (7) days, from which an average daily flow is to be developed. If any rainfall event measuring more than .5 (5/10ths) inches of rain in any of the seven (7) twenty-four (24) hour periods occurs, the monitoring shall continue to provide at least seven (7) days without rainfall.

Flow monitored data shall be adjusted for other potential loadings as appropriate, (i.e. seasonal usages, tourist loading, etc.) as may be developed or estimated from water use records, percentage of increased occupancy or other rational methods approved by the JWSC.

ADWF for existing facilities that may be scheduled for **upgrading to accommodate additional flows** from proposed developments shall be made using a combination of flow monitoring and REU calculations.

**Figure LS-1
Sewage Flow Table**

FACILITY	Gallons/Day (GPD)
Assembly Hall	5 per seat
Barber Shop/Beauty Parlor	125 per chair + 20/employee
Boarding House*	100 per room
Bowling Alley	75 per lane + 20/employee
Church w/o Day Care or Kindergarten	5 per sanctuary seat
Correctional Institution/Prison	250 per inmate
Country Club, Recreation Facilities Only	25 per member
Day Care Center, No Meals	15 per person
Dental Office	100 per chair + 20/employee
Department Store	10 per 100 SF
Factory	
Without Showers	25 per employee
With Showers	35 per employee
Food Service Establishments*	
Restaurants (Up to 12 hours per day)	35 per seat + 20/employee
Restaurants (12 hours per day to 18 hours per day)	50 per seat + 20/employee
Restaurants (Above 18 hours per day)	75 per seat + 20/employee
Bar and Cocktail Lounge	30 per seat + 20/employee
Drive-in Restaurant	50 per space + 20/employee
Carry-out Only	50 per 100 SF + 20/employee
Funeral Home	10 per 100 SF
Hospital	
Inpatient	300 per bed
Outpatient	275 per bed
Hotel*	100 per room
Kindergarten, No Meals	15 per person
Laundry, Commercial	1,000 per machine
Laundry, Coin	150 per machine
Lodges*	100 per room
Mobile Home Park	300 per site
Motel*	100 per room
Nursing Home*	150 per bed
Office	10 per 100 SF
Physician's Office	200 per exam room
Schools*	
Boarding	100 per person
Day, Restrooms Only	12 per person
Day, Restrooms and Cafeteria	16 per person
Day, Restrooms, Gym and Cafeteria	20 per person

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FACILITY	Gallons/Day (GPD)
Service Stations, Interstate Locations	425 + 150 per pump
Service Stations, Other Locations	300 + 100 per pump
Service Station Car Wash	500 per stall
Shopping Center (Not including food service or laundry)	10 per 100 SF
Stadium	5 per seat
Supermarket/Grocery Store	20 per 100 SF
Theater	5 per seat
Travel Trailer Park*	
With Independent Water & Sewer Connection	175 per site
Without Independent Water & Sewer Connection	35 per site
Warehouse	10 per 100 SF
*Add 300 gallons per machine to amount indicated if laundry or dish washing machines are installed	

Note: Where historical data is available from flow monitoring or other approved devices as in the case of existing systems, ADWF shall be as averaged from seven (7) days within the monitoring period of flow with no rainfall event greater than .5 (5/10ths) inches of rain in any of the seven(7) twenty-four (24) hour periods being averaged.

4.2.2 Peaking Factors

Upon calculation of the anticipated ADWF in gallons per day for the basin that is to discharge to the pumping facility, a peaking factor of 2.0 shall be applied to the average daily flow expressed in gallons per minute, (ADWF in gpd / 1,440 minutes per day = ADWF in gpm), to account for the daily (diurnal) peak flow in gallons per minute. This gpm figure with the Peaking Factor being applied shall be the required pump rate for the facility; (i.e. 46,080 gpd/1,440 minutes per day = 32 gpm ADWF * 2.0 = 64 gpm = required pump rate). This factor has been determined adequate for pump sizing in the JWSC jurisdictional area and is based on a series of flow monitoring studies conducted on existing lift station basins ranging in size from 25 REU's to 200 REU's (per capita populations of 65 to 520, respectively).

4.3 SIZING OF FORCE MAINS

The discharge piping, to include valves, bends and the force main is to be considered an integral part of the lift station pumping system whether the facility is new or being upgraded to handle additional flows.

Force mains and associated discharge piping for a single family use lift station discharging to gravity shall be sized for peak flow (required pump rate) at a minimum velocity of 2.0 fps with one pump running and a maximum velocity of 5.0 fps with both pumps running in a duplex station.

For triplex or quadraplex facilities velocity shall not exceed 5.0 fps with two or three pumps running respectively.

Common force mains for low pressure or STEP type systems shall be sized for the flow of the planned system based on the probability analysis of simultaneous pump operation in each pressure zone and line segments common to pressure zones. Line velocities, based on this analysis, shall be a minimum of 2.5 fps at least once during the 24 hr diurnal cycle and no greater than that velocity necessary to discharge the highest head pump on the pressure zone at 11 gpm.

4.4 WETWELL DESIGN CRITERIA

4.4.1 Wetwell Volume

The minimum required wet well storage volume between the SCADA High Water Alarm Level and the all pumps “off” level (top of the submersible pump motor or the required submergence of a self-priming pump suction leg) shall be calculated as follows:

$$\text{Required Volume} = V_R = .25TQ + V_L + V_A$$

Where:

T = Minimum Cycle Time (see table below)

Q = Required Pump Rate

V_L = Lag Level Volume

V_A = SCADA High Water Alarm Level Volume

Pump Hp	Minimum Cycle Time (T)
<20	15 Minutes
20 to 100	20 Minutes
>100	25 Minutes

The distance/volume between the pump “off” level, mid-motor pump housing elevation to the wet well bottom is subject to pump dimensions and is not considered useable volume. The designer shall be responsible for calculating this additional vertical distance and adding this additional wet well depth.

4.4.2 Wetwell Level Control Settings

To reduce wetwell turbulence caused by cascading influent that results in odor/corrosion problems and air entrainment, and to provide wet well structures that are in large degree self-cleaning, this Standard requires that the invert of the wet well influent line coming from the contributing system influent manhole be set at the mid-motor elevation of submersible pumps or at the required submergence elevation of suction lift pumps plus 0.5 feet. This vertical increment will ensure a reasonable time period of free flow through the gravity influent line and influent manhole at the design pump rate and thereby the full development of self-cleansing velocity, through these structures as required in this standard.

Based on this requirement, the design settings for level control in wet wells shall be as follows:

Low Water Level (LWL) Alarm : Top of submersible pump volute.

Pump “Off” Level (Pump Off): 50% immersion of submersible pump motor mid-point of pump motor housing or pump manufacturers minimum water level, whichever is greater.

Lead Pump “On” Level (Pump On): The vertical dimension in the design wetwell from the Pump “Off” level needed to store the volume required by $V=0.25TQ$.

Lag Pump “On” Level (Lag On): Pump On Level + 0.5 vertical feet (6 inches) Lag Pump On settings for triplex or quadraplex pump installations shall follow the same dimensional protocol of 6 inch increments and be labeled as **Lag2 On, Lag3 On**, etc.

SCADA High Water Level (SHW): Highest Lag On level + 0.5 vertical feet (6 inches). This elevation shall not exceed the influent manhole lowest invert elevation or lowest invert elevation in the wetwell if an influent manhole is not used.

Audio/Visual High Water Level (AVHW): SCADA HW elevation + 0.5 feet (6 inches). This level setting is intended to mitigate neighborhood alarm noise complaints and the only setting that allows a surcharge of the lowest contributing gravity sewer system main entering the influent manhole.

Where primary level control is provided by a Level Transducer, the AVHW float ball and installation shall be as specified for all such devices in this Standard.

Note: Where flow matching pumping systems are approved for use, (either by VFD or mechanical flow matching technology using pre-rotation basin technology), level control settings shall be by specific facility design and as approved by the JWSC.

4.5 DEDICATED WASTEWATER LIFT STATIONS

Lift stations to be dedicated shall have a minimum required pumping rate of 22 gallons per minute (gpm) at peak diurnal flow and a minimum upstream contributory loading of 16,000 gallons per day (gpd) as calculated in Paragraph 4.2 of this Standard.

Lift stations not meeting this standard, shall be privately owned, operated and maintained under the supervision of a Licensed Georgia Wastewater Collections System Operator. Such privately owned facilities and their contributing gravity systems shall be considered Satellite Systems of the JWSC requiring an agreement with the JWSC to discharge to the Public System.

Any future consideration by the JWSC to accept Public ownership of a privately owned facility shall be precedent upon such facility's adherence to this Standard or upgrade to this Standard.

4.5.1 Lift Station Types

4.5.1.1 Low Flow Lift Stations

Low Flow Lift Stations shall be defined as those facilities whose loading requires pumping capacities between 22 gpm and 79 gpm. These facilities are intended to serve limited areas where the service area cannot be expanded and wastewater service cannot be otherwise provided by on-site (septic) systems or low pressure systems capable of discharging to Public gravity. Such facilities, where approved, shall be grinder pump duplex stations meeting all criteria of this Standard.

4.5.1.2 Standard Lift Stations

Standard Duplex Lift Stations shall be defined as those facilities whose loading requires pumping rates between 80 gpm and 749 gpm.

Standard Triplex Lift Stations shall be defined as those facilities whose loading requires pumping rates between 750 gpm and 3,000 gpm. Triplex facilities shall be flow proportional and be equipped with an automatic standby power generator.

Standard Quadraplex Lift Stations shall be defined as those facilities whose loading requires pumping rates greater than 3,000 gpm. Quadraplex facilities shall be flow proportional and be equipped with an automatic standby power generator.

4.5.1.3 Initial/Ultime Lift Stations

Initial/Ultime Lift Stations shall be defined as those facilities whose initial loading requirement is significantly less than the ultimate loading requirement as determined by a submitted and approved build-out plan. Such facilities shall be designed to meet all criteria of this Standard with exceptions as noted herein.

4.5.2 Site Requirements

The property, on which the facility is constructed, is to include the influent manhole and all related lift station appurtenances.

4.5.2.1 Site Dimensions

Minimum site dimensions of the property shall be as follows:

- a. Four (4) foot and five (5) foot diameter wet wells – minimum 30' x 30' (restricted to Low Flow Stations)
- b. Six (6) foot and eight (8) foot diameter wet wells – minimum 50' X 50'
- c. Ten(10) foot diameter and greater – minimum 60' X 60'
- d. Rectangular structures – minimum 60' X 60'
- e. Irregular sites and site sizes may be considered by the JWSC where atypical conditions exist.

4.5.2.2 Fencing

Fencing is required on all sites and shall be placed a minimum of two (2) feet inside of all site property lines and constructed as follows:

- a. The fence shall be six (6) feet high, consisting of two (2) inch mesh by nine (9) gauge aluminum coated steel fabric with green PVC coating, conforming to the latest revision of ASTM A-491. The fence shall have a seven (7) gauge aluminum coated steel coil spring tension wire along the bottom of the fence fabric.

Three strands of twelve and one-half (12-½) gauge aluminum coated steel of barbed wire with four (4) point aluminum barb spaced five (5) inches apart mounted on the barbed wire support arms shall be installed along the top of the fence fabric.

- b. The posts shall be galvanized line posts, two and a half (2 ½) inch O.D. (3.65 lbs per ft); galvanized corner posts, three (3) inch O.D. (2.27 lbs per ft) with extra long pressed steel sleeves. Corner and gate post shall have necessary struts and tie bracing. Provide water tight closure caps on all posts.
- c. Gate shall be a pair of 8'-0" long (sixteen (16) foot total width) six (6) feet high sections and shall be equipped with a prop post center latch and hasp assembly. A ground anchor cast in concrete shall be provided. Gates shall be factory fabricated, green PVC coated conforming to the latest revision of ASTM A-429 and equipped with gate holders. Duckbill backstops shall be provided for swing side of both gate sections.
- d. The gate entrance shall be set back at least twenty feet from a public or private road in order to allow vehicles to pull off the road before opening the gate.
- e. Where aesthetics are a concern, the fencing cloth may be interwoven with vinyl stripping to obscure the site from public view. The color of stripping shall be dark green.

4.5.2.3 Site Access, Ground Cover and Drainage

- a. The entire site shall be covered with a geotextile filter fabric covered with six (6) inches of compacted crusher run (GAB) stone. Stone shall be clean with no soil or foreign material present.
- b. The graveled area shall be treated with a high quality, long lasting, EPA environmentally approved weed killer.
- c. Site shall be serviced by a twelve (12) foot wide all weather road with top of road above the two (2) year flood elevation.
- d. Drainage structures and conveyances shall not be allowed and no catch basin shall be located within the pumping station site. The entire site shall graded such that storm water runoff sheet flows outwards and away from structures and other appurtenances and into proper drainage channels.

- e. No site shall be located within the backwater of any lake, pond, ditch, canal or other water body without such flood level being taken into consideration by raising the site grade, the structure openings or providing watertight structure hatches above such backwater levels. The twenty-five year flood elevation shall be the governing factor if backwater levels are not historically available or known.
- f. Pump stations shall be designed and located on the site so as to minimize the effects resulting from odor, noise, and lighting.
- g. Where the location of the facility would require backing onto a public road to leave the site an area along the access or at the facility gate shall be wide enough to provide a service vehicle turnaround.
- h. Any proposed on-site landscaping or specialized ground cover being considered to improve the aesthetics of the site or block the site from view shall be approved by the JWSC. No trees will be permitted within the property boundary.

4.5.2.4 Site Electrical Power

- a. All power lines within the site shall be underground. No overhead power line will be allowed to cross the site.
- b. All facilities shall be served with three-phase power. If three-phase power is not available the Design Engineer shall submit a copy of written communication from the commercial power provider stating at what cost three-phase power would be available. In cases where pump station location has been optimized for both elevation and power supply and providing three-phase power costs are disproportionately high, variable frequency drives (VFD's) will be considered to operate the three phase motors. Prior written approval will be required from the JWSC to utilize single-phase power. Add-a-phase units are not allowed.
- c. A facility yard light and pole shall be provided for night operations and security purposes. The light shall be a 120V 500W Quartz or Halogen floodlight pointed at the control panel. The light shall be placed on a switch with a 24-hour timer capable of illuminating the facility on a selectable periodic basis. The switch and timer shall be housed in a weather-proof enclosure on the light pole. The light pole shall extend a minimum of twelve (12) feet from grade with the light fixture mounted within one (1) foot of its top for maximum coverage.

4.5.2.5 Facility Water Supply

- a. The facility shall be provided with a one (1) inch water service line for clean-up use and testing.
- b. The water service line shall be protected with the installation of a reduced pressure backflow assembly installed within the fenced enclosure. The RPZ shall be in accordance with Paragraph 2.4.6.2 of these Standards and Specifications.

Where requested by the JWSC, the backflow preventer piping shall be provided with a 4-20 milli-amp pressure transducer to sense area potable water pressures.

- c. The water service line shall incorporate a frost-proof yard hydrant. Yard hydrants are to be stainless steel and have locking capability. No water meter will be required for water use at lift stations.

4.5.2.6 Facility Bypass Pumping Connection

A facility bypass pumping connection shall be provided in accordance with the ***JWSC Standard Details***.

- a. The facility shall be provided with an external connection to the force main serving the station for use during emergency and maintenance situations.
- b. The bypass connection shall be sized to the diameter of the main pumps discharge line and be set downstream from the isolation valves of the main pump piping header.
- c. The bypass connection shall be provided with a plug valve, set on the underground horizontal run to the bypass connection, and a check valve and CAM Lock with cap set on the aboveground horizontal run to the pump connection point.
- d. The bypass connection shall be placed and oriented on the site to facilitate the setting of a bypass pump between the influent manhole and the bypass connection.
- e. The bypass connection shall be provided with a 3'x3'x6" concrete slab base.
- f. The point of attachment to the bypass connection shall be oriented horizontal and not protrude above its concrete slab more than 1 foot.

- g. The bypass connection piping and fittings shall be epoxy lined "Sewer-Safe" D.I.P. with exterior coating the same as the lift station discharge header piping.

4.5.2.7 Facility Elevation Benchmark

A Standard Brass Benchmark shall be set into the wet well slab top with the NAVD88 Mean Sea Level Elevation stamped on the face of the benchmark by a Georgia Registered Land Surveyor. An alternate location for the benchmark may be approved where structure configuration is atypical.

4.5.3 Wetwell Configuration

4.5.3.1 Size and Depth

- a. The maximum wetwell depth, as measured from the wet well rim to the lowest point of the sump, shall not exceed 20 feet.
- b. The minimum circular wetwell diameter shall be 6 feet; (surface area 28ft²), for all but low flow stations for which wet well diameters of five (5) feet shall be used.
- c. The minimum rectangular wetwell dimensions, where approved for special applications where wetwell depth is critical, shall be 6 feet by 6 feet or other dimension providing an equal or larger surface area; (surface area 36ft²).
- d. Where the JWSC has approved a facility having an initial and an ultimate flow design, the wetwell shall be sized for the ultimate pump rate whereas the storage height (and consequent level control settings) shall be established on the initial pump rate. The level settings shall be as stipulated in Paragraph 4.4.2 of this Standard.

4.5.3.2 Piping and Equipment Layout

- a. All wetwell inverts and pump intake sumps shall be configured to provide self-cleaning characteristics. Water surface levels at low water level shall be minimized to allow the removal of debris before the pump loses prime during a manual maintenance pump-down by operators.

- b. The wetwell shall have only one (1) influent line with its invert set 0.5 feet above the “Pump-Off” (mid-point of pump motor housing elevation), and it shall enter the wetwell coplanar, (aligned parallel and in-line), with the pump discharge lines in accordance with the **JWSC Standard Details**.
- c. The wetwell inverts shall be sloped downward from the top of the submersible pump motor toward the wet well pump sump at a 60 degree angle from the vertical. Flat areas for pump connection discharge elbows shall be eliminated or sloped with coated grout materials as much as possible to shed debris (**See the JWSC Standard Details**).
- d. The wetwell pump sump geometry shall provide for the required spacing between pumps, sump walls and floor as required by the manufacturer while simultaneously minimizing the water surface area at the “lowest” water level (top of pump) to allow the vortex to engulf floating solids quickly before the pump loses prime during periodic cleaning cycles in manual operation.
- e. The wetwell shall be provided with appropriately placed adjacent sleeves, 24 inches below finished grade, for access of the power and control conduits. The sleeves shall be of proper size to accommodate all necessary power and control conduits.
- f. Where the design flow of the station requires a pressure transducer for level control, an additional sleeve shall be required. It shall be placed 24” below finished grade and centered between the discharge legs. The sleeve shall be 2” in diameter. A slotted 6” PVC/HDPE joint of pipe shall be installed within the wet well, between the discharge legs, to serve as the housing and stilling well for the transducer. The stilling well shall terminate at the level of the pump intakes and be securely fastened to the discharge piping. The transducer shall be set within the stilling well at the low water level elevation of the station (**See JWSC Standard Details**).

4.5.3.3 Ventilation

The ventilation for the wet well shall be designed as a passive gravity ventilation system where the air volume in the wet well is either increased or decreased as the wastewater level fluctuates due to inflow and outflow. The passive ventilation shall be sized to vent at a rate equal to the maximum pumping rate of the station, not to exceed maximum permissible design airflow through the vent pipe of 600 feet per minute (fpm). Passive “gooseneck” vents shall be turned down so that the opening faces the top slab of the wet well.

The minimum allowable passive vent diameter shall be 6 inches. Stainless steel screens shall be required to prevent birds and/or insects entry into the wet well. The vent shall be placed diametrically opposite of the control panel. Vent piping shall be 304 stainless steel.

4.5.3.4 Access Hatches

Access hatches shall provide the required clear opening for pump removal and be set in the concrete top so as to allow the pump to be removed through the approximate center of the hatch. The hatch material shall be Aluminum Alloy 6063-T5 & T6, one-fourth (¼) inch plate, with flush type lock and inside spoon handle having a live load capacity of 300 pounds per square foot. The frame shall be equipped with a stainless steel hinged and hasp-equipped cover, two (2) upper guide bar holders and stainless steel chain holders. The door shall be torsion bar loaded for ease of lifting, shall have a safety locking handle in the open position and safety grate. All fastening hardware used inside the wet well shall be stainless steel.

- a. Pump access covers shall be suitably sized to provide adequate clearances for installation and removal of the pumping units.
- b. Hatches should be sized for the ultimate pump design. The access hatch should be designed for a minimum width of 36" or 6" beyond the manufacturer's minimum required width, whichever is greater.
- c. The minimum hatch length should be forty-eight (48) inches for standard duplex stations and ninety-six (96) inches for triplex stations or the sum of the pump width, centerline pump separation, plus twelve (12) inches, whichever is greater.
- d. Low Flow Station hatches shall be sized to adequately remove the pumps and shall not be required to adhere to the minimum requirements.

4.5.4 Precast Concrete Structures

4.5.4.1 Materials

Precast wet well bases, sections and related structures shall conform to the requirements of ASTM C478 (specification for precast concrete manhole sections and structures) except as modified herein. Cement shall be minimum 4,000 psi concrete meeting the requirements of ASTM C150 (specification for Portland cement, type II).

Minimum wall thickness shall be 1/12th the inside diameter in inches plus one (1) inch. Ring reinforcement shall be custom-made with openings to meet indicated pipe alignment conditions and invert elevations. Bases for wet wells shall be cast integrally with the bottom section.

A Flexible Neoprene-EPDM pipe connector, conforming to ASTM C443 shall be used to connect the sewer influent pipe to the precast concrete wet well. The connector shall be a minimum of three-eighths (3/8) inches thick or greater and resistant to ozone, weathering, aging, chemicals and petroleum products. The securing bands shall be stainless steel and screw assembly and totally non-magnetic Series 304 stainless steel. The connector shall be of a size specifically designed for the specified pipe material and size. The interior annular space between the exterior of the pipe and the interior of the connector shall be filled with a Type II lean cement grout. The exterior (below grade) of precast concrete wet wells shall be given two coats of an approved bituminous water proofing materials.

4.5.4.2 Corrosion Protection

The interior corrosion protection for precast concrete wet wells shall be in accordance with the following schedule based on detention time of sewer flow from the uppermost region of the contributing pipe reach using an average velocity of two (2) feet/sec.

**Figure LS-1
Interior Corrosion Protection Table**

Vapor H2S	Corrosion Risk Level	Detention Time	Corrosion Protection
0-10 PPM	No or Low Risk	<2 Hours	None
11-50 PPM	Moderate Risk	2 - 4 Hours	Coal Tar Epoxies
>50 PPM	High Risk	>4 Hours	Calcium Aluminates Epoxy Coatings Approved Coating Systems

- a. Corrosion protection for *High Risk Wet Wells* shall be hydrogen sulfide resistant cementitious products containing calcium aluminates applied one-half (1/2) inch to three-fourths (3/4) inches of thickness onto all interior surfaces after proper substrate preparation; precast wet well structures manufactured of calcium aluminate cement concrete or precast structures with approved epoxy coatings applied a minimum of 150 mil thickness.

Alternatives that provide equal or better protection may be approved. A (ten 10) year warranty will be required.

- b. All wet wells designed with the intention of being used as a receiving wet well from upstream lift stations, or considered by the JWSC to be Regional Lift Stations, shall be considered *High Risk Wet Wells*.

4.5.4.3 Installation

The base section shall be set in a twelve (12) inch (minimum) leveling course of granular material (57 stone). Precast concrete sections shall be set so the wet well will be vertical and with sections in true alignment.

All holes in sections used for their handling and the annular space between the wall and entering pipes shall be thoroughly plugged with an approved, non-shrinking mortar or grout, applied and cured in strict conformance with the manufacturer's recommendations, so that there will be zero leakage through openings and around pipes. The mortar shall be finished smooth and flush with the adjoining interior and exterior wall surfaces.

Joint contact surfaces shall be formed with machined castings and shall be exactly parallel and sealed with a joint sealer over the entire joint surface. Joints shall be water tight. Excess joint sealer shall be trimmed flush with the inside and outside surface of the structure.

All exterior joints of precast concrete wet well shall be sealed with one twelve (12) inch wide exterior joint sealant membrane centered on the joint. The tape shall be capable of sealing joints against groundwater infiltration. The installation of the membrane shall be in conformance with the recommendations of the manufacturer. The concrete surface must be smooth, clean, dry and free of voids, loose aggregate, dirt or other matter that will hinder the adhesion of the membrane. A primer shall be used in accordance with the recommendations of the membrane manufacturer.

4.5.5 Fiberglass Structures (Alternate Construction Material)

Fiberglass wet wells, when approved for use by the JWSC, shall meet the following requirements.

4.5.5.1 Materials

Unless otherwise noted by the JWSC, a circular fiberglass wet well may be used in lieu of a precast concrete wetwell. The fiberglass wet well shall be designed (signed and sealed) by a Georgia Professional Engineer and meet all applicable configuration criteria as shown in Paragraph 4.5.3 of this Standard.

The wet well shall include a twenty four (24) inch (minimum) thick twelve (12) inch thick inside the wet well and twelve (12) inch thick outside the wet well reinforced concrete hold-down base which extends twenty four (24) inches beyond the outside of the wet well, a six (6) inch (minimum) thick reinforced concrete top slab, pump access frame and cover and other standard wet well features. Pumps shall be anchored to a one (1) inch thick steel plate.

Fiberglass reinforced polyester wet wells shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. The resin system shall be suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection systems. The wetwell shall be a one-piece unit unless otherwise approved by the JWSC.

The resins used shall be a commercial grade unsaturated polyester resin.

The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

If reinforcing materials are used on the surface exposed to the contained substance, they shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

Fillers, when used, shall be inert to the environment and wetwell construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than one-half (1/2) inch in diameter, delamination and fiber show.

The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than one-half (1/2) inch in diameter, and wrinkles of one-eighth (1/8) inch or greater in depth. Surface pits shall be permitted up to six (6) square feet if they are less than three-fourths (3/4) inch in diameter and less than one-sixteenth (1/16) inch deep.

The bottom to be fabricated using fiberglass material as stated in Paragraph 4.5.5.1 with material and installation to meet all physical requirements of Paragraph 4.5.5.4 below. The Bottom shall be attached to wetwell pipe with fiberglass layup to comply with ASTM D3299 specifications. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to wet well bottom.

The fiberglass wet well top shall be fabricated using fiberglass material as stated in Paragraph 4.5.5.1 with material and installation to meet all physical requirements of Paragraph 4.5.5.4 below. The top is to be attached to wetwell pipe with fiberglass layup to comply with ASTM D3299 specifications. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to wetwell top.

4.5.5.2 Pipe Connections

Effluent, service, or discharge lines may be factory installed. Approved methods are PVC sewer pipe, Inserta-Tee fittings, or Kor-N-Seal boots. The installation of stub outs shall be fiberglass layup to comply with ASTM D3299 specifications.

4.5.5.3 Defects Not Permitted

Any of the following defects observed or present in the finished structure shall be cause for rejection.

- a. Exposed fibers: glass fibers not wet out with resin.
- b. Resin runs: runs of resin and sand on the surface.
- c. Dry areas: areas with glass not wet out with resin.
- d. Delamination: separation in the laminate.
- e. Blisters: light colored areas larger than one-half (1/2) inch in diameter.
- f. Cracking: cracks caused by sharp objects.

- g. Pits or Voids: air pockets.
- h. Wrinkles: smooth irregularities in the surface.
- i. Sharp projection: fiber or resin projections necessitating gloves for handling.

4.5.5.4 Physical Requirements

LOAD RATING: The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs. To establish this rating, the complete wetwell shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than one-fourth(1/4) inch at the point of load application when loaded to 24,000 lbs.

STIFFNESS: The wet well cylinder shall have a minimum pipe-stiffness value shown in the following table when tested in accordance with this Article of the Standard:

LENGTH (FT)	F/AY (PSI)
0 TO 10	1.26
10 TO 20	2.01

PHYSICAL PROPERTIES:

	HOOP	AXIAL
Tensile Strength (PSI)	18,000	5,000
Tensile Modulus (PSI)	800,000	700,000
Flexural Strength (PSI)	26,000	4,500
Flexural Modulus (PSI)		
Without Ribs 48", 60", 72"	1,400,000	700,000
With Ribs 96", 144"	700,000	700,000

TEST METHODS: Tests shall be performed as specified in ASTM D3753, Section 8

4.5.5.5 Backfill Material

Unless shown otherwise on the drawings, sand or crushed stone shall be used for backfill around the wetwell for a distance of two feet from the outside surface and extending from the bottom of the excavation to the bottom of the top slab. Suitable material chosen from the excavation may be used for the remainder of the backfill.

The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the JWSC. Backfill material shall be free of vegetation or other extraneous material. Excavated materials which are to be used for fill or backfill may be stockpiled on the site. Top soil should be stockpiled separately and used for finish grading around the structure.

- a. Backfill operations shall not begin until the concrete has been allowed to cure and the forms removed.
- b. Backfill shall be placed in layers of not more than twelve (12) loose measure inches and mechanically tamped to at least 95% Standard Proctor Density. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the structure.

4.5.5.6 Documentation

Each wetwell shall be marked with the following information.

- a. Manufacturer's name or trademark
- b. Manufacturing special number
- c. Total length and nominal diameter

Marking shall be placed on the interior wall of the wetwell near the top so as to be readable after installation.

4.5.6 Influent Manhole and Wetwell Influent Line

All lift stations shall be equipped with only one influent line to the wetwell to serve as an approach pipe to the self-cleaning wet well pump sump, and one influent manhole to facilitate bypass pumping.

4.5.6.1 Influent Manhole

The influent manhole shall be located within the fenced lift station enclosure area or extension thereof and placed on the same side of the wetwell as the bypass pump connection. The horizontal distance between the wet well and the influent manhole shall be the greatest possible horizontal distance within the confines of the site; however, at a minimum the horizontal distance shall be one (1) foot of horizontal separation for every one (1) foot of vertical wet well depth to avoid taking both structures out if construction work on either is necessary in the future.

All influent manholes shall be outside drop manholes with the influent line being a minimum of two (2) vertical feet above the manhole invert to provide a nominal pumping range during bypass operations. The influent manhole shall be five (5) foot in diameter minimum. Where a wetwell diameter less than the 6 foot minimum is approved, the influent manhole may be four (4) foot in diameter.

The corrosion protection on the influent manhole shall be the same as that required on the wetwell at the site. The manhole frame & cover on the influent manhole shall be a JWSC Standard thirty-two (32) inch frame & cover.

4.5.6.2 Wet Well - Influent Line

The effluent line from the influent manhole to the wet well shall enter the wet well 0.5 feet above the "Pump-Off" (mid-point of pump motor housing) elevation, be at least one nominal diameter larger than the largest diameter influent line coming from the basin gravity sewer system and be sloped no greater than 2% and no less than needed to provide self-cleansing velocity at the facility design pump rate. Larger diameter lines between the influent manhole and wet well may be considered where pump range volume is an issue so long as self-cleaning velocity at the pump-off level is obtained.

4.5.7 Wetwell and Discharge Header Piping

4.5.7.1 Interior Piping

All interior wet well discharge piping shall be epoxy lined/exterior coated Class 53 Flange by Flange Ductile Iron Pipe (DIP) with 316 Stainless Steel nuts, bolts and washers; or, IPS DR 11.0 (160 psi) Flange by Flange High Density Polyethylene (HDPE) with 316 Stainless Steel backup rings, nuts, bolts and washers. Each discharge leg shall be one continuous pipe joint. All nuts, bolts and accessories within the wet well shall be 316 Stainless Steel.

4.5.7.2 Exterior Piping

All pipe and fittings outside of the wet well and above ground shall be epoxy lined "Sewer-Safe" Class 53 Flange by Flange Ductile Iron Pipe (DIP). All bolts, washers and nuts shall be 316 Stainless Steel. Bolt threads shall be coated with "Never Seize" type coating. All above ground pipe, fittings and valves shall receive two coats of an exterior coating of "moisture cured aluminized urethane" or epoxy paint with surface preparation in accordance with the paint manufacturer's recommendation. The paint color shall be tan.

All header discharge piping, fittings and valves shall be constructed approximately three (3) feet above grade and horizontal to the top of the wet well.

Adjustable pipe stands constructed of 304 Stainless Steel – one and one-half (1 ½) inch all thread into a two and one-half (2 ½) inch SCH 40 pipe w/ nine (9) inch by nine (9) inch by a quarter (¼) inch base plate fixed with four (4) seven-sixteenth (7/16) inch X three (3) inch lag bolts at the corners shall be provided as support. The strength and number of pipe stands may vary depending on header length and weight.

4.5.8 Valves and Appurtenances

All lift station pumps shall be equipped with an isolation valve, check valve and discharge gauge fitting on its discharge header. The common manifold header for the pumps shall be equipped with combination air/vacuum air release valve and an isolation valve to isolate the entire pumping system from the serving force main.

4.5.8.1 Isolation (Plug) Valves

Lift Station Isolation valves on submersible pump installations shall be Plug Valves mounted horizontally on the discharge header.

- a. All plug valves shall be of non-lubricated, eccentric plug type with Buna “N” neoprene, epoxy or fusion bonded, nylon faced plugs. Valve bodies shall be ASTM A126, Class B cast iron with all exterior mounted bolts and nuts to be stainless steel.
- b. Port areas of four (4) inch through twelve (12) inch valves shall be 100% of full pipe area.
- c. The valve seat material shall consist of either a welded in one-eighth (1/8) inch overlay of 90% pure nickel, or 316 Stainless Steel screwed into the cast iron body.
- d. Upper and lower plug stem bearings shall be sleeve-type of a stainless steel or other non-corrosive bearing material.
- e. The packing shall be adjustable and the bonnet shall be bolted.
- f. All bolts, nuts and washers shall be 316 Stainless Steel.
- g. The valves shall be rated for a minimum of 150 psi, and shall provide drip-tight shut off with this pressure in either direction.
- h. The interior of all plug valves shall be epoxy coated.

- i. All plug valves eight (8) inches and larger shall be equipped with totally enclosed worm gear actuators complying with AWWA C504. All gearing shall run in oil. The actuator housing shall be semi-steel with seals to prevent dirt or water from entering the housing. Shaft bearings shall be permanently lubricated bronze bushings. Appropriately sized hand wheel operators shall be provided for each gear-actuated valve.

4.5.8.2 Check Valves

Lift Station Check Valves on submersible pump installations shall be swing check valves mounted horizontally on the discharge header.

- a. All check valve interiors shall be fully coated with a liquid thermosetting epoxy suitable for use in wastewater applications.
- b. Swing Check valves shall conform to the requirements of AWWA C508.
- c. Swing Check valves larger than two (2) inch nominal size shall be cast iron body with stainless steel bolts and nuts, flanged ends, 316 Stainless Steel shaft connected to a steel outside lever and stainless steel spring, swing-type with straight-away passageway of full pipe area. The valve shall have renewable bronze seat ring and rubber-faced disc.
- d. Swing Check valves larger than two (2) inches shall be 150 psi working pressure.
- e. Swing Check valves two (2) inches and smaller nominal size shall be all brass swing check valves, 200 psi working pressure.
- f. All check valves shall be placed upstream of the pump isolation valve.

4.5.8.3 Air Release Valves

Lift Station Air Release Valves on submersible pump installation discharge headers shall be combination (air release and vacuum release) type valves placed on the discharge header manifold piping upstream of the manifolds station isolation valve on the common header.

- a. Combination air release valves shall be two (2) inch inlet (minimum), stainless steel internal trim (including float, lever arm, leakage, etc.), stainless steel assembly bolts, stainless steel backwash accessories including quick disconnects and stainless steel ball valves (gate valve are also acceptable). The body of the air valve shall be 316 Stainless Steel or iron or steel body with fusion bonded epoxy (twelve (12) Mils thickness, minimum) or ceramic coating (inside and outside surfaces) or nylon plastic.

4.5.8.4 Discharge Gauge Fittings

Discharge Gauge fittings shall be installed on the discharge header pipe of each submersible pump.

- a. The gauge fitting shall be installed on discharge header pipe a minimum of six (6) inches upstream from each pumps check valve.
- b. The gauge fitting shall be installed by drilling and tapping a one-fourth ($\frac{1}{4}$) inch NPT hole, installing a 316 Stainless Steel nipple (approximate two (2) inches in length), attaching a one-fourth ($\frac{1}{4}$) inch Stainless Steel ball valve, another 316 Stainless Steel nipple (approximately two (2) inches in length) to the ball valve, and attaching a one-fourth ($\frac{1}{4}$) inch NPT Quick Connect coupler to the nipple.
- c. One (1) four and one-half ($4 \frac{1}{2}$) inch diameter face glycerin filled Wika discharge gauge, graduated in 1 psi increments (0 – 60 psi) and one (1) foot increments of H₂O (0 – 140 feet H₂O) scale range, with quick-disconnect, shall be provided for each submersible pump. Gauges shall be provided in plastic protective cases and equipped with quick disconnects.

4.5.9 Pumping Equipment

Lift station pumps shall be submersible pumps and shall meet the following requirements.

4.5.9.1 General Requirements

All pumps designed and selected shall be within +/- 20% of the pumps best efficiency point. When possible, the pump selection shall be made in the center of the family of curves.

Where the JWSC has approved the station to be designed as an initial/ultimate facility, the pump's base elbow should be sized for the ultimate pumps. The pump manufacturer shall provide an adapter plate for the initial pumps.

4.5.9.2 Submersible Pumps

Submersible Pumps and installation shall be in accordance with the follow minimum standards:

- a. Pumping equipment shall be premium quality submersible non-clog pumps for sewage service. Wet-pit pumps shall be complete with a submersible electric motor, floor-mounted discharge base and elbow, guide rails, motor electrical cable (minimum forty (40) feet in length) to connect at the demarcation box (no splicing allowed) and all other appurtenances specified or otherwise required for proper operation.
- b. Equipment furnished and installed shall be fabricated, assembled, erected and placed in proper operating condition in full accordance with drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer, unless exceptions are noted and approved by the JWSC.
- c. Pump performance shall be stable and free from cavitations and noise throughout the specified operating head range at minimum suction submergence. Pump shall be designed so that reverse rotation at rated head will not cause damage to any component.
- d. Major pump components shall be of gray cast iron. All exposed nuts, bolts, washers, anchor bolts and other fastening devices coming in contact with sewage shall be 316 Stainless Steel.
- e. The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The impeller shall be semi-open or enclosed one-piece casting with no more than two non-clog passages and must pass a minimum three (3) inch solid. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft. All interior water passages and impeller shall be coated with an approved epoxy coating to increase efficiency and resist wear.

- f. Pumps shall have mechanical seals, which shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement. The seals shall not rely upon the pumped media for lubrication and shall not be damaged if the pump is run un-submerged for extended periods while pumping under load. Mechanical seals shall be solid hard faced, (not laminated type). The bottom seal shall be tungsten carbide or silicon carbide material. The top seal may be carbon-ceramic, tungsten carbide or silicon carbide material. Replaceable or adjustable wear rings shall be provided for all pumps.
- g. All mating surfaces (pump assembly), of major components shall be machined and fitted with o-rings where watertight sealing is required.
- h. The pump manufacturer shall furnish a discharge base and discharge elbow for the pump supplied. The base shall be sufficiently rigid to firmly support the guide rails, discharge piping and pump under all operating conditions. The base shall be suitable for bolting to the floor, (bolting to a standard one (1) thick metal plate), of the wet well. The face of the discharge elbow inlet flange shall make contact with the face of the pump discharge nozzle flange. The pump and motor assembly shall be a "quick disconnect" type connected to and supported by the discharge base and guide rails allowing the pump to be removed from the wet well and replaced without the need for unbolting any flange, lowering the liquid level or requiring operating personnel to enter the wet well. Pump shall be provided with a sealing flange and guide rail sliding bracket. The bracket shall be designed to obtain a leak proof seal between flange faces as final alignment of the pump occurs in the connected position. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions. Metal to metal mating surfaces are acceptable, if machined finished.
- i. The pump shall be driven by a totally submersible electric motor. Pump motor shall be of sufficient horsepower as to be non-overloading over the entire length of the pump curve. The stator housing shall be a watertight casing. Motor insulation shall be moisture resistant, Class F, 155 degree C. at a minimum. Motors 25 HP and larger shall be VFD rated including Class H winding insulation. Motor shall be NEMA Design B for continuous duty at 40 degree C ambient temperature and designed for at least 10 starts per hour.

All motors shall be 3 phase. Motor bearings shall be anti-friction, permanently lubricated type. Motor shall be designed to operate in a totally, partially or non-submerged condition without damage to the motor. Pump cable assembly shall bear a permanently embossed code or legend indicating the cable is suitable for submerged use. Cable sizing shall conform to NEC requirements. The cable shall enter the pump(s) through a heavy-duty stainless steel assemble with grommet. The system used shall ensure a water tight submersible seal. Cable shall terminate in a junction chamber. Junction chamber shall be sealed from the motor by a compression seal.

- j. All rotating parts shall be machined and in near perfect rotational balance as possible. Excessive vibration shall be sufficient cause for rejection of the equipment. The pump impellers shall be re-balanced after being trimmed.
- k. Pump shall be equipped with two guide rails (no cable wire assembly). Guide rails shall be a minimum of two (2) inch diameter and sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to the access hatch cover at the top of the wet well. Intermediate rail braces shall be supplied and solidly secured to the wet well wall. Braces secured to the discharge piping shall not be accepted. Guide rails and brackets shall be 316 Stainless Steel.
- l. A heavy duty chain and shackle appropriately sized (3/8" minimum) for removing and installing the pump shall be selected and provided by the pump manufacturer. Unless approved otherwise by the JWSC, the lift chains shall be shackled to a heavy duty 316 Stainless Steel lifting bail attached to the pump/motor housing for removal and reinstallation. Three feet of excess chain above the top of the wet well shall be provided to expedite removal. A chain/motor electric cable holder shall be provided and appropriately sized to accommodate the lift chains and motor electrical cables provided without deformation. Chain/electric cable holder shall include extra heavy duty three-eighths (3/8) inch rod hooks for attaching control floats, lifting chains, and other wet well accessories (6 hooks minimum) and be located on the side of the wet well hatch opening opposite to the discharge piping. The chain, shackles, lifting bail, and cable holder shall be 316 Stainless Steel.
- m. Exterior of pump shall be coated with manufacturer's standard finish.

- n. Pump discharge base shall be leveled, plumbed and aligned into position to fit connecting piping. The discharge base shall be solidly secured to the wet well floor using a one (1) inch thick steel hold-down plate and appropriately sized 316 Stainless Steel anchors then grouted after initial fitting and alignment and before final bolting of the discharge piping. This work shall be inspected by the JWSC prior to any liquid being allowed into the wet well. After final alignment and bolting, pump discharge base and all connections shall be inspected. If any movement or opening of any joints is observed, any and all piping, including pump discharge base, shall be corrected.

4.5.9.3 Grinder Pumps

Grinder Pumps and installation (for Low Flow Stations only) shall be in accordance with the follow minimum standards:

- a. Pump shall be of the centrifugal type with an integrally built grinder unit and submersible motor. The grinder unit shall be capable of macerating all material in normal domestic and sewage including reasonable amounts of foreign objects such as small wood, sticks, plastic, thin rubber, sanitary napkins, disposable diapers and the like into fine slurry that will pass freely through the pump and two (2) inch discharge pipe connection.
- b. Stator winding shall be of the open type with Class F insulation rated for 130°C (266°F) maximum operating temperature. All motors shall be 3 phase. Motors shall have two heavy duty ball bearings to support the pump shaft and take the radial and thrust loads. Ball bearings shall be designed for 50,000 hours L-10 life. Stator shall be heat shrunk into the motor housing.
- c. The common motor, pump and grinder shaft shall be of 416 Stainless Steel, threaded, on the pump end, to accept the impeller and grinder assembly.
- d. The motor shall be protected by two mechanical seals mounted in tandem in a seal chamber. The seal chamber shall be oil filled to lubricate the seal faces and transmit the heat from the shaft to the outer motor shell. The bottom seal shall be tungsten carbide or silicon carbide material. The top seal may be carbon-ceramic, tungsten carbide or silicon carbide material. Seal faces shall be carbon ceramic and lapped to a flatness of one light band. An electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal.

Water in the chamber shall create an alarm condition. The alarm condition signal shall not stop the motor but act as a warning only, indicating that service is required.

- e. The pump impeller shall be of the recessed type to provide an open and unobstructed passage through the volute for the ground solids. The impeller shall be constructed of cast iron and shall be threaded onto a stainless steel shaft. The grinder assembly shall consist of a grinder, an impeller and a shredding ring and shall be mounted directly below the volute passage. Grinder impeller shall be threaded onto a stainless steel shaft and shall be locked to the shaft with a screw and a washer. The shredding ring shall be pressed into an iron holding flange for easy removal and replacement. Shredding ring shall be reversible for double life without disassembly of the pump unit. The holding flange shall be provided with tapped holes such that screws can be used to push the shredding ring from the housing. All grinding of solids shall be from the action of the impeller against the shredding ring. Both the grinder and the shredding ring shall be constructed of 440C stainless steel hardened to 58 to 60 on the Rockwell C scale.
- f. All iron casting shall be pre-treated with a phosphate and chromic rinse and shall be painted before machining. All machined surfaces exposed to sewage shall be repainted. All pump and motor fasteners shall be 316 Stainless Steel.
- g. All mating surfaces of the pumps major components shall be machined and fitted with o-rings where seating is required.
- h. The motor power cord shall be rubber coated wire and shall be fastened by means of a cord grip in the top of the pump. The motor shall contain a waterproof junction box, which will provide space to connect the power cord to the motor leads. The motor leads shall seal between the motor housing and the junction box by means of a rubber compression fitting around each wire. The power cord shall have a green carrier ground conductor that attaches to the motor flange.
- i. The pump manufacturer shall furnish a discharge base and discharge elbow for the pump supplied. The bases shall be sufficiently rigid to firmly support the guide rails, discharge pipe and pump assembly under all pumping conditions. The base shall be bolted to the well floor and sealed on the wet well exterior to prohibit any intrusion or leakage from the wet well. The face of the discharge elbow inlet flange shall make contact with the face of the pump discharge nozzle flange.

The pump and motor assembly shall be a quick disconnect type connected to and supported by the discharge base and guide rails allowing the pump to be removed from the wet well and replaced without the need of unbolting any flange, lowering the liquid level or requiring operating personnel to enter the wet well. Pump shall be provided with a sealing flange and a guide rail sliding bracket. The bracket shall be designed to obtain a leak proof seal between the flange faces as final alignment of the pump occurs on the connected position. The bracket shall maintain proper contact and suitably sealed connection between flange faces under all operating conditions.

- j. All rotating parts shall be machined and in near perfect rotational balance. Excessive vibration shall be sufficient for rejection of the equipment. The impellers shall be rebalanced after being trimmed.
- k. Pump shall be equipped with two (2) guide rails. Guide rails shall be a minimum of one (1) inch diameter and sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to the access hatch cover at the top of the wet well. Guide rails and brackets shall be 316 Stainless Steel.
- l. A heavy duty chain and shackle appropriately sized (one-fourth (1/4) inch minimum) for removing and installing the pump shall be selected and provided by the pump manufacturer. The chain shall be 316 Stainless Steel and attached.

4.5.9.4 Pump Warranty

PUMP WARRANTY (Solids Handling and Grinder Pumps):

- a. The manufacturer shall warrant to the JWSC, for permanent installation in municipal sewage service, submersible pump and motor against defects in materials and workmanship including normal wear and tear to the following parts:
 - i. mechanical seals
 - ii. bearings, shafts
 - iii. motor electrical cables
 - iv. motor stators.

The warranty shall include no less than 100% coverage for original equipment manufactured (OEM) parts and in-shop labor for pump/motor repairs for a minimum of eighteen (18) months at NO COST to the JWSC. This warranty shall not apply to parts that fail due to abuse, neglect, mishandling, or acts of God. The warranty period shall commence upon the date of final acceptance for use of the pumping station and/or of a replacement pump by the JWSC and upon completion of manufacturers startup.

- b. During the warranty period, the pump distributor shall, at no cost to the JWSC, transport and repair the defective pump/motor within forty eight (48) hours or provide a loaner capable of maintaining the operation of the JWSC site. Where, due to the size of the pump/motor a forty-eight (48) hour repair is not feasible and/or a loaner is not available, the distributor shall cover the cost of an appropriately sized engine driven back-up pump to be installed at the site to maintain the station until the pump is repaired and reinstalled or until a loaner is provided. This clause shall only be invoked where the lift station site is considered critical and the availability of only one operating pump at the facility would create a high liability situation. This judgment call shall be at the sole discretion of the JWSC.

4.5.10 Site Electrical Work

4.5.10.1 General

All wiring shall meet the requirements of the National Electrical Code. All wiring outside the control panels shall be enclosed in rigid PVC conduit sized for 40% fill unless indicated otherwise. A separate conduit shall be used for each pump power cable sized for not more than 40% fill. Each conduit shall be sealed gas tight with duct seal putty at motor control panel entry.

4.5.10.2 Electrical Service

The pumping station incoming service shall consist of type THW or XHHW copper conductors in rigid PVC conduit installed a minimum of forty-eight (48) inches below final grade. Electric service shall be sized as required by ultimate station electrical loadings.

Electric service shall be routed within Public rights-of-way, or if approved due to special considerations, within dedicated easements. As-Built documentation shall include a diagram indicating actual routing from utility transformer/s to station meter and to control panel.

If overhead service, an electrical pole shall be set outside of the pump station fencing then installed underground within the pump station's fenced enclosure.

4.5.10.3 Control Panel Connections

The power line and each motor line shall enter the bottom of the motor control panel separately and each in SCH 40 PVC sized as per National Electric Code. Each line shall travel directly from motor control panel to the pump motors and contain only one pulling 90 degree elbow at the base of each panel/box.

The motor control panel and service shall be grounded per NEC Article 250 and utilize a minimum of two grounding electrodes at least six (6) feet apart and eight (8) feet deep. The neutral conductor shall not serve as the grounding conductor to the main breaker panel. A separate conductor shall be used for this purpose. Grounding system shall be zinc coated and buried so as not to present a trip hazard above vapor barrier and below gravel.

4.5.11 Electrical Equipment and Controls

Controls shall be compatible with pumps supplied meeting both pump manufacturer requirements and the minimum standard below pump supplier shall assume sole source responsibility for pumps and controls.

4.5.11.1 General Requirements

Pump motors greater than or equal to 20 Hp shall require a 480 volt service. If a pump motor is less than 20 Hp, but the kilo-volt-amperes (kVA) as determined by the equation:

$$\text{kVA} = (\text{Total Load}) \times (\text{Voltage}) \times (1.73/1000)$$

is greater than 150, a 480 volt service shall be used. Otherwise, a 230 volt service may be used.

If the pump motor is less than 25 Hp, across the line starters can be used. Therefore, pump breakers are sized by multiplying the full load amperage (FLA) for the specific motor at the appropriate voltage by 300% and rounding up to the nearest breaker size.

If the pump motor is over 25 Hp, VFD's are required. Therefore, pump breakers are sized by multiplying the full load amperage (FLA) for the specific motor at the appropriate voltage by 200% and rounding up to the nearest breaker size.

If the JWSC has approved the station to be designed as an initial/ultimate station, the pump breakers shall be sized for the initial pumps. The dimensions of the control panel shall accommodate the ultimate size components.

The Main and Emergency breaker sizes shall be determined by adding the pump breaker size, the FLA of additional pump motors (beyond the one), and any auxiliary loads and rounding down to the nearest breaker size. If the total load for a 240-volt service is less than or equal to 100 Amps, 100 Amp emergency and main breakers should be used. If the total is greater than 100 and less than 200 Amps, round down to the nearest available breaker size, but, set the service size to 200 Amps. If the total is greater than 200 Amps, the service size shall be the same as the emergency and main breaker size. Where the JWSC has approved an initial/ultimate station, the main and emergency breakers, as well as service size shall be designed for ultimate design conditions.

Starters shall be sized corresponding to the NEMA ratings.

If the JWSC has approved the station to be designed as an initial/ultimate station, the starters shall be sized for the ultimate pumps with a note added to the drawings stating: "**Heater coil sized to protect the initial pumps**".

4.5.11.2 Submersible Lift Station Motor Control Center

Submersible Lift Station Motor Control Center (MCC) shall be constructed in accordance with UL 508A requirements for enclosed industrial control panels and shall bear the UL508A serialized label.

A. Enclosure

- i. Minimum submersible lift station enclosure size for Motor Control Panel shall be forty-eight (48) inches high, thirty-six (36) inches wide and twelve (12) inches deep.
- ii. Minimum low flow submersible lift station enclosure size for Motor control Panel shall be thirty-six (36) inches high, thirty (30) inches wide and twelve (12) inches deep.
- iii. All control components shall be housed in a NEMA 12/4x316 stainless steel enclosures rated NEMA 12 with dip shield resulting in a NEMA 12/4 x rating. The enclosure shall have a single handle and a 3 point latch system with padlock feature (no keyed locking handles will be accepted.)

- iv. The enclosure shall have a brushed finish and collar studs. The enclosure shall also have 90 degree flanged lip all around where the outer door makes contact with enclosure to make a more efficient seal.
- v. The enclosure shall have a hinged inner door(s) (dead front) fabricated from 0.125 inch thick marine alloy grained aluminum. The inner door shall have an adjustable latching mechanism to keep door firmly closed and shall be comprised of captive hardware. The inner door(s) shall have stainless steel hardware to be secured open for service.
- vi. The enclosure shall have a twelve gauge steel, formed, removable sub panel. The sub-panel shall be degreased, cleaned, treated with phosphate process, then primed and painted with white industrial grade baking enamel.
- vii. The enclosure and mounting system shall be devices to keep them open when service is being rendered. Mounting system to be as shown in the JWSC Standard Detail.
- viii. Enclosures shall be sized to enable all breakers and controls to be located not more than five (5) feet zero (0) inches above grade or the walkway.
- ix. Construction of MCC III type panels shall have VFD manufacturer recommended cooling as part of overall panel construction.

B. Panel Components

At a minimum, the panel shall consist of the following components:

- i. Motor Starter/Controller - one per pump
- ii. Thermal Magnetic Circuit Breakers - one per pump
- iii. Circuit breaker operators (thru inner door type) - one per pump
- iv. Power Monitor - one
- v. Alarm Light - one
- vi. Duplex GFI Receptacle – two (2)
- vii. Generator Receptacle and Manual Transfer - one (if not equipped with a generator set and automatic transfer switch)

- viii. Hand-Off-Automatic Selector Switch - one per pump
- ix. Moisture Sensors - one per pump
- x. Heat Sensors - one per pump
- xi. Audible Alarm Device
- xii. Relays - six (11 pin 120 VAC with matching sockets)
- xiii. Indicator Lights (LED Type) for "Run", "Seal Fail", and "Over Temperature" - one set for each pump
- xiv. RTU Circuit Breaker
- xv. Power Distribution Block
- xvi. Lightning Arrestor - one
- xvii. Elapsed Time Meter - one per pump
- xviii. Thermostatically Controlled Panel Heater
- xix. Control Transformer when 480 Volt, 3-phase power is used

C. Motor Starter/Controller

To extend the useful life of the pump station components including the pump and motors, one of the following two (2) starter/controllers is required for each pump/motor based upon the motor horsepower. A minimum eighteen (18) month warranty is required on all starter/controllers (including VFD equipment). The warranty shall include materials or workmanship which does not conform to these specifications.

- i. **Type "one" (MCC I):** 0-25 HP 208/230 VAC started across the line shall be protected at 300% of nameplate FLA (full load amperage), using NEMA motor starters.
- ii. **Type "two" (MCC II):** 26 HP and above 460/480 VAC, requires a variable frequency drives with an internal bypass protected at 200 % of motor nameplate FLA.

Motor Starters (MCC-I Only): Motor Starters shall be NEMA rated Magnetic Motor Starter with solid state overload relay with life time coil warranty.

Overload relay includes phase loss and phase unbalance. Device must be manufactured to ensure full voltage is applied to coil even at 85% of nominal eliminating contact chatter and premature contact failure. When lower than acceptable voltages are applied the motor starter will not start or will break the circuit to prevent contact chatter. Starters shall be mounted twelve (12) inches (minimum) from the bottom of the cabinet.

Variable Frequency Drive (VFD) Controllers (MCC II Only): The Variable Frequency Drive shall be rated for input voltage. The variable frequency drive shall be microprocessor based control for three phase induction motors. The VFD's shall be Pulse Width Modulated (PWM) design. Adjustable current source VFD's are not acceptable. Insulated Gate Bipolar Transistors shall be used in inverter section. Bipolar Junction Transistors, GTOs or SCRs are not acceptable. The VFD's shall have efficiency at full load speed that exceeds 97% for motors over 40HP. The VFD's shall limit harmonic distortion onto the utility system to a voltage and current level as defined by IEEE 519 for general systems applications, by using the standard 3% nominal impedance integral ac three phase line reactor.

The system containing the VFD's shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the VFD provided with standard input line reactor or optional input isolation transformer, the VFD manufacturer shall supply a multiple bridge rectifier AC to DC conversion section with phase shifting transformer for all drives above 100 horse power. The multiple rectifier converters shall cause multiple pulse current waveforms that will more neatly approximate a true sine wave to reduce voltage harmonic content on utility line. Harmonic filters are not acceptable above 100HP. The device shall be capable of communicating with JWSC approved programmable logic controller with optional Profibus communication capability. The VFD's shall be mounted a minimum of twelve (12) inch from bottom of cabinet.

D. Thermal Magnetic Circuit Breakers

- i. Protector operators are to be quick make, quick break and trip free. The thermal and magnetic elements shall operate independently and multiple pole breakers be designed with common trip bar breaking all poles when a fault is received on any pole.
- ii. All "Normal Main" breakers shall be minimum "E" frame. "E" frame circuit breakers shall contain a self-test "Trip Selector" permitting a mechanical simulation of the over current tripping device and shall be rated a minimum of a 460 Volt @ 14 KAIC for 240 Volt systems

and 600 Volt @ 18KAIC for 460/480 Volt systems. The use of Q-frame breakers is not acceptable.

- iii. All "Emergency Main" breakers shall be minimum "E" frame. "E" frame circuit breakers shall contain a self-test "Trip Selector" permitting a mechanical simulation of the over current tripping device and shall be rated a minimum of 460Volt @ 14KAIC for 240 Volt systems and 600 Volt @ 18 KAIC for 460/480 Volt systems. The "Emergency Main" breaker current rating must be equal to or less than the current rating of the generator receptacle. The use of Q-frame breakers is not acceptable.
- iv. All "Pump" breakers shall be minimum "E" frame. "E" frame circuit breakers shall contain a self-test "Trip Selector" permitting a mechanical simulation of the over current tripping device and shall be rated a minimum of 460 Volt @ 14 KAIC for 240 Volt systems and 600 Volt @ 18 KAIC for 460/480 Volt systems. The use of "MCP", Motor Circuit Protectors or Q-frame breakers is not acceptable.
- v. All "Control" breakers shall be rated for 120/240 @ 20 KAIC (Q Frame).

E. Circuit Breaker

Each circuit breaker shall be mounted with breaker handles extending through the dead front panel door.

F. Audible Alarm

A horn shall be provided on the left hand upper side of enclosure and shall sound upon high level at 90db at ten (10) feet. A silenced push button shall be mounted on exterior bottom left of cabinet to energize a relay to disconnect the horn when pressed. Horn will be wired to allow remote silencing via the local RTU and radio link.

G. Alarm Light

A red alarm light shall be provided and shall be mounted using threaded stainless steel pipe to top of panel.

H. Duplex GFI Receptacle

Two GFI duplex receptacles shall be provided, one to be mounted on the appropriate weather proof enclosure and the other to be mounted on the outside bottom right hand side of the cabinet. The receptacle face shall be flush with front of cabinet and be supported as required by NEC. The receptacles shall be rated 20 amps, 125vac.

I. Generator Receptacle

A generator receptacle shall be mounted in accordance with the standard detail. A 30° panel mounting adapter and flip cover shall be supplied. The generator receptacle must be sized equal to or greater than the current rating of the Emergency Main breaker. The generator receptacle shall not be required if a generator set is installed on the site.

J. Manual Transfer Switch

If Automatic Generator is not specified, a manual transfer switch shall be provided with one normal power circuit breaker and one emergency power circuit breaker interlocked mechanically to prevent both breakers from being closed at the same time. The emergency breaker will be fed from the generator receptacle. Panel manufacturer is to size breaker and receptacle per facility requirements.

K. Hand-Off-Automatic Selector Switches

A three position selector switch shall be provided for each pump and be mounted on the inner door. The switches shall be heavy duty 30mm devices.

L. Moisture Sensors

The panel shall be equipped with moisture sensing relays for each pump energizing red status indicator lights mounted on the dead front and send a signal to the PLC. Relays shall not disconnect control power to the pumps. Indicator lights shall remain energized until manually reset.

M. Heat Sensors

The panel shall be equipped with heat sensing relays for each pump energizing red status indicator lights, mounted on the dead front and send a signal to the PLC. Relays shall not disconnect control power to the pumps. Indicator lights shall remain energized until manually reset.

N. Power Monitor

A power monitor relay shall be installed and connected to the control circuits. When the power to the RTU is deactivated it shall disconnect control power from the motor starters and open the 24vdc monitor circuit to the RTU and shall have a dedicated set of contacts to provide input for the RTU. The power monitor relay shall be deactivated in the event that any of the following two (2) conditions occur and shall have a dedicated set of contacts to provide input to RTU.

- i. Phase loss (single Phasing) when one of any three lines drops to 83% of nominal voltage.
- ii. Low voltage (brown out) when all three line voltages drop to 85% or less of nominal voltage.

O. Relays

All relays shall be large ice cube style case and be 3 poles double throw octal type relays for all 120 volt applications. Relays must be standard 11 pin octal type relays with contacts rated 10 amps @ 120VAC. Relays are to have internal LEDs and test push button as standard. Matching 11 pin sockets shall be supplied.

P. Indicator Lights

Lights shall be provided to indicate Pump Run, Seal Fail, (each pump) and motor over temperature (each pump). Indicator lights shall be LED type heavy duty 30mm.

Q. RTU Circuit Breaker

RTU shall be powered through a 20 ampere circuit breaker "Q" Frame.

R. Power Distribution Block

Power distribution block with touch safe cover shall be provided, sized for 600 volt, 175 amps minimum. The power distribution block shall have a flammability rating of UL 94V-0 and shall be based upon NEC. Power block shall be Busmann 16 series.

S. Lightning Arrestor

A secondary arrestor, complying with ANSI 62.2 shall be installed in accordance with manufacturer's instructions on the outside bottom of the cabinet.

T. Elapsed Time Meters

Elapsed Time Meters shall be five digits non-resetting interfaced with appropriate motor starter and shall be mounted on the dead front door. One will be required for each pump.

U. Level Control Systems

Lift station level control systems shall be either floats or Level Transducer in accordance with the following guidelines:

- i. All Low Flow Lift Station with a design pump rate between 22 gpm and 79 gpm shall be float controlled;
- ii. All Standard Duplex Lift Stations with a design pump rate between 80 gpm and 349 gpm shall be float controlled;
- iii. All Standard Duplex Lift Stations with a design pump rate between 350 gpm and 749 gpm shall be Level Transducer controlled, with the exception of the Audio/Visual High Water Alarm system, which shall be by float;
- iv. All Triplex, Quadraplex and Initial/Ultimate Lift Stations shall be Level Transducer controlled, with the exception of the Audio/Visual High Water Alarm system, which shall be by float.
- v. **Where a Level Transducer level control system is required**, the transducer shall be installed within a slotted six (6) inch DR-11 HDPE casing pipe installed within the wet well as follows:
 - a. The transducer casing pipe shall be placed between the pump intakes on submersible installations, to serve as the housing and stilling well for the transducer assembly;
 - b. The stilling well pipe shall be open on both ends and slotted between six (6) inches from the bottom and twenty-four (24) inches from the bottom with slots approximately three (3) inches center to center; slots shall be one-half ($\frac{1}{2}$) inch wide by four (4) inches long and cut on opposite sides of the pipe.
 - c. The stilling well shall terminate on the "wet" end at the level of the pump intakes in the pump sump or in a sloped recessed area constructed in the sump invert that provides the same elevation relative to the pump intakes.

- d. On submersible installations, the stilling well pipe on the dry end shall terminate approximately two (2) feet below the access hatch and on the same side of the wet well as the guide rails.
- e. Stilling well pipe shall be vertical and plumb to facilitate removal for cleaning and maintenance of the transducer.
- f. On submersible pump installations the casing shall be securely fastened to guide rail brackets with 316 Stainless Steel brackets and off-set so as not to interfere with the installation/removal of pumps.
- g. The transducer shall be set within the stilling well casing at the **Low Water Level** elevation. At the Low Water Level (LWL) elevation in the wet well the transducer calibration setting shall correlate with the “zero” depth of water level.

Level Transducer: The submersible level sensor, where required, shall be a solid state instrument designed to continuously measure and transmit liquid level data. The transducer shall have a 4-20ma output with 24 VDC supply. The transducer shall be calibrated for 0 – 24 feet of water. Transducer shall have conduit adapter, and cable length as required by the installation. The transducer shall not have a breathing (vent line) or boxes. Transducers shall be capable of field calibration and shall have a manufacturer’s one year warranty from date of installation. The transducer shall be in stainless steel housing. The transducer shall be installed in a stilling well as described in this article of the Standard. The electrical connections shall be (two) 2 wire, shielded waterproof cable attached to a terminal strip with screwed connections.

Level Control: Floats, where required, shall activate when switch is horizontal and deactivate when liquid level drops below the activation elevation. The float shall have a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the switch with the entire assembly encapsulated to form a completely water tight unit. The float shall be mounted from above on a 316 Stainless Steel hanger.

V. Control Transformer

Control transformer shall be 480 Volt Primary, 120 Volt Secondary sized as necessary to carry all connected loads.

W. Control Wiring Identification

All wiring shall be color coded sized as follows:

120 VAC (Un-switched Hot) #12 AWG Black
120 VAC (Dry Contacts) # 12 AWG Red
120 VAC (Neutral) # 12 AWG White
120 VAC (Switched Hot) # 12 AWG Red
24 VDC + # 16 AWG Orange
24VDC - # 16 AWG Brown

Control Wiring shall be numbered or lettered at each end. Wire numbers/letters shall be Pass & Seymore "Legrande" or JWSC P&CD equal.

X. Wire Duct

All wiring shall be routed through a wiring duct system to provide protection and an organized appearance.

Y. Terminals

Terminals shall be provided for interface with field installed equipment. The terminal blocks shall be mounted on a 30 degree angle for ease of field connection.

Z. Nameplates

All components shall be labeled using a laser screen Mylar nameplate. The nameplate shall be a laminated two part system using black letters on a white background providing protection against fading, peeling or warping. The labeling system shall be computer controlled to provide logos, post-script type or custom designs. The uses of laminate or plastic engraved legend plates will not be accepted.

AA. Mounting Hardware

All components shall be mounted using stainless steel machine screws. All mounting holes shall be drilled and tapped. The use of self tapping screws shall not be acceptable.

Note: UL Labels: The entire control system shall bear a UL 508 serialized label "Enclosed Industrial Control Panel". The use of the label "Industrial Control Panel Enclosure" without the UL508 serialized label is not acceptable.

4.5.12 Remote Terminal Unit (RTU) - System and Panel

An approved manufacturer as listed in the Approved Materials Section of this Standard shall manufacture the remote terminal unit (RTU). The panel shall be constructed in accordance with UL 508A requirements for enclosed industrial control panels.

4.5.12.1 General

The manufacturer shall be responsible for all efforts necessary to select, furnish, supervise installation and connections, calibrate and to place into operation all SCADA system instrumentation and controls along with all other associated equipment and accessories.

The manufacturer shall furnish all materials necessary for a complete operational radio based SCADA System as described herein. System shall include all materials necessary to interface field instruments and devices with the various control panels and SCADA system and shall provide for surge protection of the units.

The base function of the RTU shall be to monitor the status of and provide control of lift station pumps, and to provide historic data of facility operations.

4.5.12.2 Warranty

Warranty on system function and equipment shall be two (2) years from the date of start-up. Warranty shall include any problems (to include lightning and other surges) which prevent satisfactory operation of the system. Warranty shall include, but not be limited to parts, labor and travel expenses.

4.5.12.3 System Requirements

RTU's shall meet or exceed the following requirements:

- a. Each RTU shall incorporate the power supply, logic, memory, communications interface and input/output circuitry.
- b. The unit must be microprocessor based, use a 16 bit processor as a minimum and include the following capabilities:
 - i. Fused, user configurable, digital and input/output
 - ii. User configurable digitally scaled analog inputs

- iii. On-board trickle type battery charger and battery
 - iv. Bounceless changeover circuitry for primary to battery power transfer
- c. Each digital input/output shall be user configurable through either the host computer or local terminal; each must use a standard input/output module. The selected modules must provide the ability to use input signals up to 140VAC and 30VDC, and provide output signals to the interface with control voltages up to 280VAC/60VDC.
- d. Configuration of the digital inputs/outputs shall include the following as a minimum:
- i. Normally closed/open point type
 - ii. Accumulation of time on the transitions
 - iii. Accumulation of pulse counts (up to 20 per second)
 - iv. Manual/Automatic mode
 - v. Analog point type
 - vi. Enable/disable of selected features
 - vii. Run time accumulation
 - viii. Number of starts
 - ix. Time between starts
- e. Each analog input/output shall be digitally scaled to assure accuracy. Analog conversion method shall, at a minimum, use dual slope integration techniques with a least two (2) processor samples per second. Analog inputs shall have twelve (12) bit minimum accuracy available. Either voltage or current mode shall be jumper selectable on the unit for each input. Analog outputs shall have twelve (12) bit accuracy. Configuration of the analog inputs/outputs shall have the following features as a minimum:
- i. Point type
 - ii. Communication to the host computer on set point violation
 - iii. Local alarm output interface for set point deviation

- iv. Value range
 - v. Filter constant
 - vi. Low and high gain
 - vii. Low and high set point
 - viii. Set point dead band
 - ix. Set point delay time
 - x. Scaling
 - xi. Enabling/disabling of selected features
- f. RTU shall be Driver and MODBUS programmable to existing SCADA or approved equivalent
- g. Communication Modem:
- i. Modem supplied shall be MODBUS Protocol Modem or approved equivalent.
 - ii. VHF Transceiver Radio installations shall include FCC license amendment to include operations at new locations. FCC licensing shall be the approved manufacturer's responsibility to provide radio frequency and radio testing each site.
 - iii. Antenna and cable shall be selected to be compatible with the transceiver and be installed to deliver clear and reliable signals by approved manufacturer.
- h. Contact points for all SCADA systems shall at a minimum provide Input/output functionality and relays for the following settings:
- i. Off level
 - ii. Low level
 - iii. Lead level
 - iv. Lag level(s)

- v. High level
- vi. Power fail (phase failure)
- vii. Pump run status (all pumps)
- viii. Pump fail status (all pumps)
- ix. Pump enable/disable
- x. Wet Well Water level (transducer facilities only)
- xi. Water pressure (where required to monitor local water pressure on public mains)

4.5.13 Combination MCC/RTU Panel

The combination MCC/RTU panel shall include all of the components listed above for the MCC panel and for the RTU panel. The MCC portion of the panel shall include the motor starter/controller as noted in Article 4.5.11.2 of this Standard (MCC-I, MCC-II). All exceptions to the above requirements are provided below. The MCC/RTU shall incorporate all low voltage control and automation components being mounted behind the left hand dead front door. The enclosure shall have a full length aluminum barrier separating the low voltage side from the high voltage power devices. The high power components will be located behind the right hand dead front door. All pilot devices displays etc. shall be on the left hand dead front door. The main, emergency and pump breaker handles reset buttons etc. shall be on the right hand dead front door. The battery, charger and associated equipment shall be mounted near the bottom left hand side of the enclosure and the terminal blocks shall be placed approximately where the battery and charger shelf are located.

Minimum enclosure size for MCC/RTU shall be sixty (60) inches tall forty-eight (48) inches wide and twelve (12) inches deep.

All control components listed here-in shall be housed in a NEMA 12/4X 316 stainless steel enclosures and shall have inner door separating control and automation components from power related equipment.

4.5.14 Low Flow Station (Only) Remote Terminal Unit (RTU) System

The approved material section of this standard will provide a list of approved parts to be installed inside the enclosure.

4.5.14.1 General

Low flow site RTU's minimum shall be monitor only.

The manufacturer shall be responsible for all efforts necessary to select, furnish, supervise installation and connections, calibrate and to place into operation all required system instrumentation and controls along with all other associated equipment and accessories.

The enclosure shall be 14"x12"x6" weather proof NEMA 4X polycarbonate enclosure.

The parts list shall consist of the minimum parts herein:

- a. Modular Backplane
- b. Digital monitoring module card (DMM)
- c. Broadband DC block protector
- d. Radio interface module
- e. Internal coax connector (pig tail)

4.5.14.2 Warranty

Warranty on system function and equipment shall be one (1) year from the date of start-up. Warranty shall include any problems (to include lightning and other surges) which prevent satisfactory operation of the system. Warranty shall include, but not be limited to parts, labor and travel expenses.

4.5.14.3 System Requirements

RTU's shall meet or exceed the following requirements:

- a. Programming:
 - i. The device shall be configured, programmed, and setup using any standard Internet web browser software.
 - ii. All connected equipment can be monitored and configured from an internet connection to the world-wide-web.
 - iii. Screens shall be Password protected to provide secure access.

- iv. Operational programming software or user skills shall not be proprietary.
- b. Radio Communication:
- i. Communication shall be via Radio wave using DFS primary protocol or equivalent MODBUS protocol and shall communicate through the data transmission services using existing licensed frequencies.
 - ii. A factory approved antenna and mast shall be provided as part of the onsite communication structure with accordance to manufactures communication height.
 - iii. N-Series coax cable shall be installed between broadband DC block protector and the antenna.
 - iv. Antenna masts shall be anchored According to the manufactures specifications unless other inspection conflicts are noted.
 - v. All Grounding of communications shall be grounded by one (1) - eight (8) foot copper ground rod and bonded to GA Powers grounding strap.
 - vi. All antenna connections shall be protected by heat shrink.
 - vii. All mast connections shall be brass or bronze coated with galvanized coating or spray.
 - viii. FCC Licensing shall be the approved manufacturer's responsibility to provide radio frequency and radio testing of each site.
- c. Alarming and Monitoring: The device shall monitor connected alarms and analyze and report the following information with alarm notifications sent immediately, or at user selectable time delays:
- i. High water alarm (From level controller)
 - ii. Lag float alarm
 - iii. Float sequence failures
 - iv. Power failure alarm

- v. Phase monitor
 - vi. Pump 1,2 On/Off Cycles
 - vii. Starter failures
 - viii. Pump 1,2 Runtimes
 - ix. Hand / Off / Auto switch position
 - x. High pump temperature alarm, Pump #1 & #2
- d. Power Supply:
- i. Incoming electrical service shall be 115 VAC, 60 Hz, single-phase power.
 - ii. Fuse protected 12 VDC power supply shall be powered from the 120-volt incoming power and shall include tapered charge type battery circuitry to maximize battery life. The power supply shall be rated at minimum 2.0 Amps @ 12 VDC.
 - iii. A 12-volt battery charging power supply and battery backup with a 2-hour minimum operation time shall be provided.
- e. Protection: A single-phase lightning arrestor shall be connected to each line of the incoming side of the power input terminals. The installation shall include a good (minimum eight (8) foot deep) copper ground rod bonded to GA Power grounding strap.

4.5.15 Emergency Power

Lift Stations with a design capacity of 1,500 gpm or greater shall be provided with a permanently mounted on-site generator set and automatic transfer switch. Pump stations with a design capacity less than 1,500 gpm shall be equipped with a generator receptacle for use with a portable generator. Generator receptacles, where applicable, shall be matched to accommodate the use of JWSC portable generators.

4.5.16 On-site Standby Generators & Automatic Transfer Controls

On-Site generators shall be installed in accordance with NEC Article 702, Optional Standby Systems.

4.5.16.1 General

On-Site generators shall be sized by the manufacturer based upon the lift stations running electrical load and motor-starting requirements as specified by a Georgia Licensed Engineer, taking into consideration the characteristics of the generator and engine.

On-Site generators shall be sized, designed and capable of operating two pumps simultaneously on duplex and triplex facilities and three pumps simultaneously on quadraplex facilities taking into account the pump motor starting sequence delay interval. The design shall allow for a maximum 20% voltage dip at motor start of the second or third pump while the originally started pump is in full operation. Where the facility includes differing motor sizes, the largest motor shall always be started first.

The generator shall be equipped with field-forcing equipment to sustain the rated excitation and current up to three times the generator's rated output. Downstream and generator circuit breakers shall be coordinated so that the branch circuit breaker trips first. An under-voltage relay shall be provided to trip breakers and shut down the engine if over current at less than full voltage occurs for a predetermined length of time.

On-Site generators shall be powered by a diesel fueled engine capable of supplying the shaft power required by the actual/required maximum load applied to the generator. The diesel fueled generator shall be provided with a UL 142 compliant above ground fuel storage tank or integral belly tank sized to provide a minimum of 24 hours of continuous run time based on full facility power requirements and loadings.

4.5.16.2 Engine-Generator Controls

Controls shall meet or exceed the following requirements:

- a. General controls shall include:
 - i. Manual start/stop
 - ii. Auto/remote start
 - iii. Emergency stop
 - iv. Fault reset
 - v. Remote start input active

- vi. Fuel gauge
 - vii. Exercise function
 - viii. 3-Phase voltage regulator
 - ix. Fault history
 - x. Output circuit breaker
- b. Instruments for the engine shall include:
- i. Oil Pressure
 - ii. Coolant temperature
 - iii. Engine speed
 - iv. Engine running hours
 - v. Number of starts
 - vi. Battery voltage
- c. Safety controls for engine shut-down shall only be manually reset and shall include:
- i. Low oil pressure
 - ii. High engine coolant temperature
 - iii. Failure to crank shutdown
 - iv. Over crank (failure to start)
 - v. High/low battery voltage/weak battery
 - vi. Over-speed
 - vii. Low fuel
- d. Instruments for generator shall include:
- i. 3-Phase L-L and L-N voltage
 - ii. Frequency

- iii. 3 Phase current
 - iv. Kilowatt hour
 - v. Total kilovolt-amps
- e. Safety control for generator shut-down shall only be manually reset and shall include:
- i. Under and over voltage
 - ii. Under and over frequency
 - iii. Over current and short circuit
 - iv. Reverse power
- f. Instruments and controls shall be mounted on the generator control panel
- g. Actuating the safety devices shall shut-down the generator set, indicate the cause of the shut-down by lighting the appropriate indicating light, and provide separate outputs for the remote alarm indication panel and the computer.

4.5.16.3 Automatic Transfer Controls/Switches

Automatic Transfer Controls/Switches shall be provided and shall conform to all of the requirements of UL 1008 and be so listed and labeled; Bypass isolation switches that allow the ATS to be removed for repairs shall be provided.

- a. Automatic transfer switches shall be Double-throw type switches having the following ratings:
- i. Continuous rating.
 - ii. Inrush rating
 - iii. Load interrupting
 - iv. Thermal and Magnetic

- b. Automatic transfer switches shall include a pause-in-neutral position with an adjustable time delay that causes the motor to be disconnected from the power source during transfer and allows the motor voltage to collapse to a safe level prior to re-energization. Automatic transfer switch position indicating panel shall include:

4.5.16.4 Starting Batteries and Charging Systems

Starting batteries for the standby generator shall be wet cell lead-acid batteries having a cranking capacity adequately sized for the specific application.

4.5.16.5 Generator Set Enclosure

Generator Set enclosure shall be an aluminum sound attenuated weather protective enclosure with the following features:

- a. Stainless Steel hardware
- b. Compact footprint
- c. Package listed to UL 2200
- d. Fuel and electrical stub-up area within enclosure perimeter
- e. Two or more recessed doors per side, depending on dimensions.
- f. Pad-lockable doors with weather protective seals
- g. Enclosed exhaust silencer
- h. Rain collar and rain cap
- i. Access lifting points for spreader bars or forklift
- j. Window for control viewing
- k. Exterior oil and coolant drains with interior valves for ease of service
- l. Sound attenuated 70 dB(A) at twenty-three (23) feet (non-residential)

4.5.17 Lift Station Testing

Each Lift Station shall be subjected to testing in accordance with JWSC Water and Waste Water Developmental Standards and Procedures.

4.6 PRIVATE LIFT STATIONS

This section delineates the minimum standards for wastewater lift stations intended for private ownership, operation and maintenance that will discharge to the publically owned and operated gravity sewer systems or low pressure system force mains of the JWSC.

These Standards shall encompass individual residential, single property service commercial, multi-service/multi-lot facilities that require less than 22 gpm falling below the threshold for public ownership, and those facilities discharging greater than 22 gpm not “intended” for dedication by a documented “Notice of Intent” from the property owner to the JWSC.

4.6.1 General Requirements

No Publically owned and operated sanitary sewer system or lift station shall be permitted to discharge, directly or indirectly, to a privately owned and operated lift station.

All piping systems contributing flow to a private lift station shall be privately owned and operated by the facility owner and/or allowed by a documented agreement between the owners of contributing systems and the lift station owner. Such agreements shall establish the rights and responsibilities for operation and maintenance of the lift station and of the individual piping systems between the parties. The JWSC shall be provided with a copy of such agreement(s) prior to the payment of connection fees.

With the exception of individual residential and single property commercial lift stations, private lift station and sanitary sewer system owners shall be required to enter into a Satellite System Working Agreement with the JWSC prior to payment of connection fees to discharge to the public system.

Private Lift Stations of capacities suitable for dedication to the JWSC that have not been designed and constructed in accordance with the Dedicated Lift Station Standards herein stated shall not be considered for public ownership until such facility is brought to the minimum current Standards for Dedicated Lift Stations. Exempted from this policy will be lift stations designed and constructed in accordance with City of Brunswick or Glynn County Standards at the time of installation and that are functioning properly.

The served property for a low pressure connection to the public force main shall be adjacent or contiguous to the publicly owned low pressure force main; the acquisition of an easement through private property to access a low pressure system force main that is not adjacent or contiguous to the property is the responsibility of the owner.

With the exception of Single Family Residential and Single Lot Commercial Lift Stations serving only one (1), water account customer, all private lift stations shall display a sign in a prominent location at the facility fitted to a post or enclosing fence. The sign shall identify the facility as a wastewater lift station, identify the owner and provide an emergency contact phone number after the phrase “**In Case of Emergency Call**”. The sign lettering shall be large enough to be easily read from fifty (50) feet away with the lettering and sign made of durable weather resistant material.

4.6.2 Single Family Residential & Single Lot Commercial Lift Stations

4.6.2.1 Owner Responsibilities

The individual property owner shall be responsible for the selection, purchase and installation of the on-site wastewater collection and transmission system to the approved point of connection to the public facilities.

Where an existing septic system is on the property, it shall be abandoned in accordance with Environmental Health Department Standards.

All on-site pumping systems shall be installed by a Georgia Licensed Master Plumber or Utility Contractor and permitted through the appropriate local Code Enforcement Department.

The property owner shall remain responsible for the operation, maintenance, repair and replacement of all on-site systems up to the point of connection to the public system.

4.6.2.2 System Components

The lift station (pumping system) shall include a holding tank, anti-floatation collars, grinder pump and electrical and controls. An alarm system that provides a light and/or audible signal when the water in the holding tank is above the normal operating range shall be provided.

The grinder pump shall be designed to handle the required flow rate (gpm) at the estimated backflow pressure (pressure head) for the individual application being considered.

The pump line (force main) from the lift station to the point of connection to the public low pressure system force main or gravity sewer system service line shall be, at minimum, one and one-fourth (1¼) inch diameter PVC or HDPE pressure pipe. At no time shall a force main from a private pumping system lay within a public right-of-way without obtaining a road encroachment permit from the proper authorizing authority with a copy of which submitted to the JWSC with the connection application

When discharging to a public gravity sewer system, the pump line (force main) shall discharge to a gravity sewer system manhole if the force main is connected to a public gravity main within a road right-of-way. If connecting to a gravity main from private property or through an easement, the private force main shall be connected to a sanitary sewer service line in accordance with JWSC Standards for Gravity Sewer Service connections. Requirements for corrosion protection as specified in Section 3 for manholes do not apply for discharge rates of 22 gpm or less.

When connecting to a publically owned and operated Low Pressure Force Main, the pressure line from the lift station shall connect to the Low Pressure System Force Main stub-out provided for the property in accordance with the JWSC Force Main Connection Standards.

A force main crossing of property not owned by the owner of the lift station to reach a public sewer system connection point shall require an easement from the owner of the property being crossed. Such documentation shall be filed with the JWSC along with the connection permit application.

All on-site systems shall be inspected by a JWSC inspector prior to being placed in service.

4.6.3 Multi-Family, Multi-Lot and/or Multi-User Commercial Stations

4.6.3.1 Owner Responsibilities

The system owner shall be responsible for the selection, purchase and installation of the on-site wastewater collection and transmission system to the approved point of connection to the public facilities.

The system owner shall remain responsible for the operation, maintenance, repair and replacement of all components up to the point of connection to the public system.

The system owner shall be required to enter into a Satellite System Working Agreement with the JWSC prior to payment of connection fees to discharge to the public system.

4.6.3.2 System Components

System shall be designed by a Licensed Georgia Professional Engineer to pump the design peak hourly flow with one pump out of service.

System shall be designed and constructed in accordance with all applicable regulations and guidelines of the Georgia Environmental Protection Division.

System shall have a minimum of 2 pumps with each pump being of the same capacity with the rated flow of each pump being as required for the estimated daily flow in gpm + a 2.0 peaking factor.

The pump line (force main) from the lift station to the point of connection to the public low pressure system force main or gravity sewer system service line shall be, at minimum, one and one-fourth (1 ¼) inch diameter PVC or HDPE pressure pipe. At no time shall a force main from a private pumping system lay within a public right-of-way. Where a public gravity sewer main or manhole or low pressure force main is not available contiguous to the property, the owner shall acquire easements through adjoining property or properties to the point of connection approved by the JWSC.

When discharging to a public gravity sewer system, the pump line (force main) shall connect to a gravity sewer system service line draining to a manhole or gravity main in accordance with JWSC Standards for Gravity Sewer Service connections. Requirements for corrosion protection as specified in Section 3 for manholes do not apply for discharge rates of 22 gpm or less.

When connecting to a publically owned and operated Low Pressure Force Main, the pressure line from the lift station shall connect to the Low Pressure System Force Main stub-out provided for the property in accordance with JWSC Force Main Connection Standards.

A force main crossing of property not owned by the owner of the lift station to reach a public sewer system connection point shall require an easement from the owner of the property being crossed. Such documentation shall be filed with JWSC along with the connection permit application.

All on-site systems shall be inspected by a JWSC inspector prior to being placed in service.

4.7 FORCE MAINS

4.7.1 General

Force mains shall discharge to sanitary sewer gravity system manholes at the manhole invert level in such a manner as to minimize turbulence and join the normal flow of wastewater through the manhole without disrupting or impeding other flow or flows entering or passing through the manhole. Where the discharge manhole has no other flows entering it, the force main discharge shall be directed straight through the manhole, through a properly constructed invert, into the manhole effluent line.

No force main, with the exception as noted in section 4.6.2.2, System Components for Single Family Residential and Single Lot Commercial Lift Station and stations discharging less than 22 gpm), shall connect to a sanitary sewer manhole that does not meet the requirements for corrosion protection as cited in the Section 3 of these standards for the discharge manhole and downstream manholes.

No force main shall be discharged to a sanitary sewer system unless such downstream gravity system has been verified by the JWSC to have adequate capacity to accept the discharge.

Force mains shall have isolation valves installed at two-thousand (2,000) foot intervals beginning at the isolation valve installed at the lift station. Lift stations with force mains less than two-thousand (2,000) feet to the point of discharge do not require isolation valves beyond the lift station.

4.7.2 Force Main Manifolds

Other than in low pressure systems, force mains from proposed public or private lift stations may not generally be manifolded with existing publicly owned force mains. Where manifolding is recommended for a proposed lift station by the developer's or owner's engineer for consideration by the JWSC, hydraulic modeling will be required. Such modeling shall demonstrate velocities for all interconnected pipes within standard parameters as described in Section 4.7.3 to be considered.

No force main from a private lift station shall be allowed to manifold with a public force main without documented agreement shown on the approved record drawing, or by written legally binding documentation submitted to the JWSC with the connection application by the owner, accepting responsibility for any private pumping system upgrades that may become necessary if the private lift station's ability to discharge into the public force main, due to changing flow conditions in the public force main were

to occur, and/or for any damage or associated liabilities that may result as a failure of such public force main to accept the discharge from the private lift station.

Force mains from single-family residential or single lot commercial users shall only connect to publically owned Low Pressure System force mains at service connections provided at the property line or public right-of-way in accordance with these Standards.

4.7.3 Force Main Size

The minimum size pressure sewer service laterally for single-family residential or single lot commercial shall be one and one-fourth (1 ¼) inch in diameter.

Force mains for a single facility use lift station discharging to gravity shall be sized for peak flow (required pump rate) at a minimum velocity of 2.5 fps with one pump running and a maximum velocity of 5.0 fps with both pumps running in a duplex station. For triplex or quadraplex facilities velocities shall not exceed 5.0 fps with two or three pumps running respectively.

Force mains in manifolded systems, where approved, shall be sized as demonstrated by hydraulic modeling to provide a minimum velocity of 2.0 fps with the minimum of pumps operating as needed to handle the required pump rates of all connected facilities, (i.e. one pump in each duplex facility, two pumps in each triplex facility, three pumps in each quadraplex facility), and to provide a maximum velocity of 5.0 fps with the maximum of pumps operating in each facility, (i.e. two pumps operating in a duplex facility, three pumps operating in a triplex facility, four pumps operating in a quadraplex facility).

With the exception of single-family residential or single lot commercial, no public force main shall be smaller than two (2) inches in diameter while still meeting the minimum and maximum velocities in this standard.

Where the JWSC has approved an Initial/Ultimate Lift Station design concept and the parameters outlined above cannot be achieved with one force main, dual interconnected parallel force mains shall be used. The interconnection of such dual force main systems shall be designed and constructed with valving to provide the use of either force main individually or together simultaneously within required velocity and flow parameters.

4.7.4 Force Main Depth

Force mains shall be designed meeting minimum cover requirements of thirty-six (36) inches with a maximum of 60 inches. Cover shall be measured from finished grade.

Force main depths shall be designed so as to reduce or minimize the number of high points in the pipeline by varying the depth along the route as is reasonable to maintain a consistent pipe elevation. Changes in elevation which exceed two feet will require an air/vacuum release valve.

4.7.5 Force Main Location

Force mains shall be designed and constructed along the shoulder or within public rights-of-way on the opposite side from water mains.

Force mains shall be designed and constructed within appropriately sized easements dedicated to the JWSC. Easements provided shall be maintenance vehicle and equipment trafficable all weather easements.

A horizontal distance of three (3) foot minimum shall be maintained from all force mains to drainage structures, telephone duct banks, electrical transformers, signal relays, power poles, and other structures in the right-of-way as well as any other parallel underground utility with the exception of water mains.

Where force mains cross other underground utilities, with the exception of water mains, a minimum vertical separation of six (6) inch shall be maintained. All distances shall be measured from the outside edge of the pipes. The vertical separation between force mains and other crossing utilities shall be filled with a suitable pipe bedding material and compacted or filled with flowable fill to prevent settlement, contact and potential pipe to pipe abrasion caused by the vibration of flow through the force main.

Force main connections to manholes shall be cored and booted connections in accordance with Paragraph 4.7.1 of this Standard.

Force mains shall not be constructed within or below open ditch bottoms unless crossing on a perpendicular. Where crossing open ditch bottoms, the forcemain shall be a minimum of sixteen (16) inches below the bottom of the ditch and encased in concrete for the full width of the ditch as measured across the top of ditch banks.

Force mains shall be located outside of paved areas except at roadway crossings.

Sewer force main and water main separations shall be in accordance with Georgia EPD requirements and as follows:

- a. At crossings, pipe joints shall be as far as possible and equidistant from the point of crossing with the water main on top. Separation shall be measured from the outside edge of the pipe to the outside edge of the pipe. A full length of pipe must be centered at the crossing.
- b. Alternatively, at such crossings, the pipes shall be arranged so that all water main joints are at least 6' from all joints in the sewer force main.

Sewer force mains crossing major ditches, canals, streams, creeks and rivers shall be sub-aqueous crossings installed by horizontal directional drilling or other boring/tunneling method approved by the JWSC. Such crossings shall be provided with isolation valves on both sides of the crossing. Both sides of the crossing shall be treated as high points in the force main and have air release/vacuum valves installed. The placement of isolation valves and air valves shall be a minimum of fifteen (15) feet horizontally away from stream bank tops. The crossing pipe shall be perpendicular to the stream. Aerial crossings and bridge attachments shall not be permitted. No sewer force main shall be designed or constructed under ponds, lakes, retention ponds or other bodies of water other than in crossings as described above. No sewer force main shall be designed or constructed to lay closer than twenty (20) horizontal feet from the top of the bank of any body of water noted in this article.

Tracer Wire shall be provided on all installed force mains; tracer wire shall be continuous or properly spliced single strand No. 10 solid plastic coated (30 mil) copper wire from iron fitting to iron fitting.

Detection Tape shall be provided on all force mains; detection tape shall be two (2) inches wide Mylar encased metal marking tape and shall be buried eight (8) inches – twelve (12) inches below plan-finished grades.

4.7.6 Materials

4.7.6.1 Pipe

Force main piping shall be color coded green. Force main piping shall be fused joint DR 17.0 HDPE meeting the requirements of ASTM D3035 - DIP size with butt fused joints; or, SDR 21 Class 200 PVC meeting the requirement of ASTM D2241, with elastomeric integral bell gasketed joints meeting the requirements of ASTM D-3036; or, AWWA C-900 and C-905

DR-18 PVC. Where specifically approved by the JWSC for special conditions on short runs, interior coated CL52 DIP meeting the requirements of ASTM A-746, with elastomeric push-on joints, mechanical joints conforming to ANSI A-21.11, or flange joints conforming to ANSI 21.1. All bolts and bolt studs associated with flange joint pipe connections shall conform to ANSI B-16.1.

4.7.6.2 Joints

Force mains shall have mechanically restrained joints at changes in direction. The restrainer shall be manufactured of ductile iron and shall meet or exceed all the requirements of ANSI A21.11 (AWWA C111) and ASTM A536. The restrainer system shall provide anchoring ductile iron pipe and fittings, valves and PVC pipe to mechanical joint pipe or fittings, or bell to spigot PVC pipe joints. The restrainer shall accommodate the full working pressure rating of the pipe plus surge allowance. In the assembly of the restraint device, all bolts shall be tightened to the correct torque range as recommended by the restraint manufacturer. Concrete thrust blocking will not be permitted.

4.7.6.3 Fittings

Horizontal and vertical directional changes in force mains shall be accomplished with bends of 45 degrees or less and properly restrained; no 90 degree bends will be permitted.

All fittings on pvc force mains shall be inside coated "sewer safe" mechanical joint cast iron or ductile iron fittings properly restrained.

4.7.6.4 Valves

Force Main isolation valves shall be interior coated plug valves. Plug valves eight (8) inch and greater shall be provided with worm gear actuators, and extension stems with operating nut no more than eight (8) inches below finish grade.

Isolation valve/check valve connections by a new or replacement force main to an existing force main shall be by cutting-in a mechanical joint wye fitting to discharge in the direction of normal flow. Wet tapping with a "T" connection will not be permitted.

Air release valves shall be two (2) inch air release valve assemblies installed within sealed manholes. Air release valves shall be provided at all force main high points. On force mains discharging to gravity systems combination valves (air release and vacuum valves) shall be utilized in the place of air-only release. The size, depth and configuration of the sealed

Air Release/Vacuum vault shall be such as to allow the entry and work of maintenance personnel (**See JWSC Standards Details**).

4.7.6.5 Force Main Casings

Force mains crossings under major roads, railroads or other major obstructions shall be installed within a casing.

Where Steel Pipe is to be used as a casing it shall conform to either ASTM Standard A139 for "Electric Fusion (arc) Welded Steel Pipe" with minimum yield strength of 35,000 psi or "API Specification API-5LX, Grade X-42 Welded Steel Pipe". Wall thickness shall meet the requirements of the latest Revision of the American Railway Engineering Association Manual of Recommended Practice or the Georgia Department of Transportation Standard Specification for Road and Bridge construction, as applicable. For street uses which are not GDOT or railroad, use GDOT casing thickness. All pipe furnished by the manufacturer shall be cast and machined at one foundry location to assure quality control and provide satisfactory test data. Full pipe length shall be provided. No short pipe lengths less than eight (8) feet long will be allowed unless approved by the JWSC. The pipe ends shall be tapered where welding is required.

Where HDPE pipe is to be used, it shall be DR 9 HDPE meeting the requirements of ASTM D3035 and butt-fusion welded.

Casing pipe interior diameter shall, at a minimum, be twice the outside diameter of the force main being encased.

4.7.7 Force Main Testing

Force mains shall be hydrostatically tested to 1.5 times the working pressure of the associated lift stations, or 100 psi, whichever is greater in accordance with the procedures of AWWA C600. Testing shall be observed and approved by a JWSC inspector.

All installed isolation, air release and check valves shall be tested for proper operation, set and marking

Force main tracer wire shall be checked for continuity along the pipe run and checked at terminus points for proper connection.

APPENDIX 4A
ACCEPTABLE MANUFACTURERS

APPENDIX 4A

**SANITARY SEWER – LIFT STATION AND FORCE MAINS
ACCEPTABLE MANUFACTURERS**

PARAGRAPH	PRODUCT	MANUFACTURERS
4.5.2	Site Requirements	
4.5.2.6	<i>Bypass Pumping Connection Cam Lock</i>	Dixon OPW
	<i>Bypass Piping PVC 1120, Class 150, DR 18</i>	Vulcan Plastics JM Eagle
	<i>DR 18 Sewer Safe Mechanical Joint Fittings</i>	Star Pipe Sigma Corp.
	<i>Bypass Piping Ductile Iron Pipe</i>	Griffin Pipe US Pipe
	<i>Ductile Iron Pipe Sewer Safe Mechanical Joint Fittings</i>	Star Pipe Sigma Corp.
4.5.3	Wet Well Configuration	
4.5.3.4	<i>Access Hatches</i>	U.S. Foundry
4.5.4	Precast Concrete Structures	
4.5.4.1	<i>Precast Concrete Structures</i>	MST Inc. Hanson Pipe and Precast Mega Cast
4.5.4.2	<i>Moderate Risk Corrosion Protection</i>	Raven Epoxy Sewer Shield Parsonpoxy Hydro-Pox Epoxy
	<i>High Risk Corrosion Protection</i>	Spectra Shield SewperCoat Green Monster
	<i>Significant Risk Corrosion Protection</i>	SewperCoat Green Monster
4.5.5	Fiberglass Structures	
4.5.5.1	<i>Fiberglass Structures</i>	Xerxes L.F. manufacturing Flowtite
4.5.7	Wet Well and Discharge Header Piping	
4.5.7.1	<i>Interior Piping High density Polyethylene (HDPE) Pipe</i>	Performance Pipe JM Eagle Lamson & Sessions
	<i>Interior Piping Class 53 Flange by Flange Ductile Iron Pipe</i>	Star Pipe Sigma Corp.
4.5.7.2	<i>Exterior Piping Class 53 Flange by Flange Ductile Iron Pipe</i>	Griffin Pipe US Pipe
	<i>Exterior Pipe Fittings Flange by Flange</i>	Star Pipe Sigma Corp.

STANDARDS FOR WATER AND SEWER
DESIGN AND CONSTRUCTION

PARAGRAPH	PRODUCT	MANUFACTURERS
4.5.8	Valves and Appurtenances	
4.5.8.1	<i>Isolation (Plug) Valves</i>	Mueller Dezurik
4.5.8.2	<i>Check Valves</i>	Clow
4.5.8.3	<i>Air Release Valve</i>	
4.5.8.4	<i>Discharge Gauge Fittings</i>	
4.5.9	Pumping Station	
4.5.9.2	<i>Submersible Pumps</i>	Flygt, KSB, Ebarra
4.5.9.3	<i>Grinder Pumps</i>	Flygt, KSB, Ebarra
4.5.11	Electrical Equipment and Controls	
4.5.11.1 A	<i>Enclosure</i>	Hoffman APX Flygt Bison
4.5.11.2 B	<i>Panel Components</i>	Listed Below
4.5.11.2 C	<i>Motor Starters Variable Frequency Drives</i>	Square D Yasakawa ITT
4.5.11.2 D & E	<i>Circuit Breakers</i>	Square D GE Cutler Hammer Westing House
4.5.11.2 F	<i>Audible Alarm</i>	Federal Signal
4.5.11.2 G	<i>Alarm Light</i>	Federal Signal
4.5.11.2 H	<i>GFI Receptacles</i>	ISO GE Morris Levite
4.5.11.2 I	<i>Generator Receptacles</i>	Crouse Hinds
4.5.11.2 J	<i>Manual Transfer Switch</i>	Square D GE Westinghouse
4.5.11.2 K	<i>Hand Off Auto Switches</i>	Cutler Hammer Square D
4.5.11.2 N	<i>Power Monitor</i>	Diversified Electronics
4.5.11.2 O	<i>Relays</i>	NTE Allen Bradley AA Electric Idec
4.5.11.2 S	<i>Lighting Arrestors</i>	Ditek Delta
4.5.11.2 T	<i>Elapsed Time Meter</i>	ENG Yokogawa
4.5.11.2 U	<i>Level Controls</i>	Roto Float Blue Ribbon ITT
4.5.11.2 V	<i>Transformers</i>	Warrick GE ACME

STANDARDS FOR WATER AND SEWER
DESIGN AND CONSTRUCTION

PARAGRAPH	PRODUCT	MANUFACTURERS
4.5.12	Remote Terminal Unit	
4.5.12	<i>RTU (SCADA)</i>	Data Flow Systems Scadatek
4.5.14	Low Flow Station (Only) RTU System	
4.5.14.1	<i>RTU (SCADA)</i>	Data Flow Systems Scadatek
4.5.16	On-Site Standby Generators & Automatic Transfer Controls	
4.5.16	<i>Standby Generators</i>	Onan Caterpillar
4.5.16.2	<i>Engine-Generator Controls</i>	Onan Caterpillar
4.5.16.3	<i>Auto Transfer Switches</i>	Onan Caterpillar
4.7.6	Force Main Materials	
4.7.6.1	<i>SDR 21 Class 200 PVC Pipe AWWA C-900/C-905 DR-18</i>	Vulcan Plastics JM Eagle U.S. Plastic Corp.
	<i>DR 11 (HDPE) Pipe High Density Polyethylene</i>	Performance Pipe JM Eagle Lamson & Sessions
	<i>Interior Coated CL52 Ductile Iron Pipe</i>	Griffin Pipe US Pipe
4.7.6.3	<i>Sewer Safe Mechanical Joint Fittings</i>	Star Pipe Sigma Corp.
	<i>Sewer Safe Coupling</i>	HyMax Star Pipe Sigma Corp.
4.7.6.4	<i>Isolation (Plug) Valves Air Release Valves</i>	Clow Mueller

APPENDIX 4B
STANDARD CONSTRUCTION DETAILS

SECTION 5
GREASE INTERCEPTORS
OIL AND SAND SEPARATORS

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APPENDICES

Appendix 5A

Standard Construction Details

- 5-1 Precast Grease Trap – General Notes
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SECTION 5 GREASE INTERCEPTORS OIL AND SAND SEPARATORS

5.1 GENERAL

The Wastewater Pretreatment Compliance Coordinator within the Joint Water and Sewer Commission (**JWSC**) is responsible for assisting in the implementation of Article II of the Water and Sewer Ordinances of the City of Brunswick and Glynn County, Georgia. This section provides the minimum guidelines for the design and construction of grease interceptors and separators used to minimize the discharge of pollutants associated with commercial waste discharged into the sanitary sewer system which may interfere with the normal operation of said system. The method of design and/or construction shall be in accordance with accepted engineering practices, these Design and Construction Standards and Specifications and the following:

Joint Water and Sewer Commission, Water and Sewer Ordinances, City of Brunswick - Article II

Joint Water and Sewer Commission, Water and Sewer Ordinances, Glynn County - Article II

5.2 APPLICABILITY

Grease interceptors and separators are required in accordance with the above referenced ordinances at the following locations and at other locations deemed necessary by the Wastewater Pretreatment Compliance Coordinator

5.2.1 Food Service Establishments

Facilities likely to discharge fats, oils and grease which are newly constructed, or existing facilities which shall be expanded or renovated to include a food service facility where such facilities did not previously exist, shall be required to install an approved, pretreatment device/interceptor. Pretreatment devices/interceptors shall be installed prior to the opening or reopening of such facilities.

Likewise, existing commercial facilities shall be required to install an approved, pretreatment device/interceptor when any of the following conditions exist:

- i. Facilities that are found to be contributing fats, oils and grease in quantities sufficient to cause line stoppages or necessitate increased maintenance on the collection system
- ii. Remodeling of the food preparation or kitchen waste plumbing facility
- iii. Facility change of ownership or lease holder

5.2.2 Maintenance and Service Facilities

All maintenance or service facilities shall provide approved oil and solids removal equipment or facilities sufficient to meet the effluent limits set forth in the aforementioned ordinances. This also includes the remodeling of an automotive related enterprise, commercial laundry or other users that potentially may contribute wastes with petroleum-based oils, greases or lint.

5.3 DESIGN CRITERIA

Approved types of grease interceptors include either interior and exterior sealed concrete construction or pre-engineered package systems of steel or fiberglass construction. Any unit requiring the installation of an outlet filter shall have an approved sample port installed immediately outside the unit.

Oil and solids separators for use at maintenance and service establishments shall be pre-engineered package systems of steel or fiberglass construction.

Sanitary wastes shall not be routed through the devices.

5.3.1 Location

For *food service establishments*, the best location for grease pretreatment devices/interceptors is in an area outside of an outside wall and installed in-ground. An alternative device and location will be evaluated on an individual basis for facilities when space limitations prohibit the installation of an in-ground unit, or when special conditions exist, such as highly variable flows, high levels of grease discharge, or other unusual situations that are not adequately addressed by the design formulas below.

Each grease pretreatment device/interceptor shall be installed and connected so that it is easily accessible for inspection, cleaning, and removal of the intercepted grease at any time whether the unit is installed outside in-ground or inside the facility.

For *maintenance and service facilities* the unit shall be located outside of any building and accessible for proper maintenance and inspection.

For both food service establishments and maintenance and service facilities, when located in areas where additional weight loads may exist, the units shall be installed with traffic bearing covers. A separate sampling manhole may be required at the discretion of the JWSC.

5.3.2 Capacity

Capacity will be based on the following design criteria and must meet the required effluent quality parameters stated in **Section 2-16-38** of the above referenced water and sewer ordinances. Certain applications may require the installation of multiple units in series with outlet filters and approved sample port.

5.3.2.1 Grease Interceptors (Precast Concrete)

For restaurants and food service establishments, interceptor capacity shall be calculated as follows:

$$\text{Capacity} = (\text{S}) \times (\text{GS}) \times (\text{HR}/12) \times (\text{LF}) \quad \text{where}$$

- (S) = Number of seats in dining area
- (GS) = Gallons of wastewater per seat (Use 25)
- (HR) = Number of hours in operation (Daily)
- (LF) = Loading Factor (See Table Below)

Location	Loading Factor (LF)
Interstate Highways	1.25
Four (4) - Lane Highways	1.00
Two (2) - Lane Highways	0.8
Other Locations	0.5

For hospitals, nursing homes and other commercial kitchens with varied seating capacity, interceptor capacity shall be calculated as follows:

$$\text{Capacity} = (\text{M}) \times (\text{GM}) \times (\text{LF}) \quad \text{where}$$

- (M) = Number of meals per day
- (GM) = Gallons of wastewater per seat (Use 5)
- (LF) = Loading Factor (See Table Below)

Location	Loading Factor (LF)
Locations With Dishwashers	1.0
Locations Without Dishwashers	0.5

5.3.2.2 Grease Interceptors (Pre-engineered Systems)

Pre-engineered grease interceptors shall remove grease and other floatable materials, solids and other settle able materials from wastewater. The effluent from such units shall have no degreasers, surfactants or emulsifiers. The pre-engineered unit must provide adequate treatment time to limit effluent discharge levels of non-emulsified solvent extractable matter of animal or vegetable origin to a maximum of 100 parts per million (PPM) and total suspended solids (TSS) to 1,000 PPM.

Submittal data for pre-engineered grease interceptors shall include the following data as a minimum:

- Maximum Gravity Flow Rate (GPM)
- Total Liquid Capacity (Gallons)
- Grease Storage capacity (Gallons)
- Solids Storage Capacity (Gallons)

The submittal shall also include supporting calculations to justify the design flow rate of the unit, anticipated influent and effluent wastewater characteristics and any other assumptions or criteria used in the design of the unit.

The Owner shall be responsible for the proper operation and maintenance of the units and the JWSC reserves the right to require additional facilities or modifications based upon operational performance.

5.3.2.3 Pre-engineered Oil and Solids Separators

Pre-engineered oil and solids separators shall remove free oil and other floatable materials from wastewater. The effluent from such units shall have no degreasers, surfactants or emulsifiers. The pre-engineered unit must provide adequate treatment time to limit effluent discharge levels of non-emulsified solvent extractable matter of mineral or synthetic origin to a maximum of ten (10) parts per million (PPM) and total suspended solids (TSS) to 1,000 PPM.

Submittal data for pre-engineered oil and solids separators shall include the following data as a minimum:

Maximum Gravity Flow Rate (GPM)
Total Liquid Capacity (Gallons)
Grease Storage capacity (Gallons)
Solids Storage Capacity (Gallons)

The submittal shall also include supporting calculations to justify the design flow rate of the unit, anticipated influent and effluent wastewater characteristics and any other assumptions or criteria used in the design of the unit.

The Owner shall be responsible for the proper operation and maintenance of the units and the JWSC reserves the right to require additional facilities or modifications based upon operational performance.

5.4 MATERIAL SPECIFICATIONS

5.4.1 Precast Concrete

5.4.1.1 Tanks

Precast concrete tanks shall be manufactured in a National Precast Concrete Association (NPCA) certified manufacturing plant. Tanks shall be manufactured in accordance with ASTM C1613 *Standard Specification for Precast Concrete Grease Interceptor Tanks*.

The interior and exterior of all precast concrete tanks shall be sealed with Conseal CS55 or an equivalent moisture barrier sealant. The interior shall be light gray or white in color while the exterior may be any color.

Any knockouts shall leave a minimum concrete thickness of one (1) inch in the tank wall. They shall accommodate a minimum four (4) inch and maximum six (6) inch diameter pipe. No knockouts or openings shall be permitted below the tank liquid level. Any inlet opening or knockout shall be positioned such that at least one (1) inch clearance will exist between the top of any inlet tee and the bottom surface of the tank top or access opening insert. Both the inlet and outlet openings may have seals cast into the tank.

All tanks shall be provided with a concrete partition, sealed with Conseal CS55 or an equivalent moisture barrier sealant, so that the tank contains two compartments. The partition shall be located at a point not less than two-thirds (2/3) the length of the tank from the inlet end.

The partition shall contain a knockout one-third (1/3) down from the top of the wall which shall accommodate a minimum four (4) inch and maximum six (6) inch diameter standpipe.

5.4.1.2 Piping

All pipe and fittings used in conjunction with the tank shall be Type I Schedule 40 PVC meeting the requirements of ASTM D2665. Inlet and outlet pipes shall be sealed with a cast in place low-pressure pipe seal or equivalent neoprene gasket, flexible silicon adhesive or cement.

The inlet tee shall extend down a minimum of 25% and a maximum of 50% of the total liquid depth. It shall extend at least five (5) inches above the liquid level. The inlet and outlet tees shall be positioned at least eight (8) inches from the tank wall and be accessible through the access openings. The invert elevation of the outlet tee shall be at least two (2) inches lower than the invert elevation of the inlet tee. The outlet tee shall consist of a Polylok PL625 effluent filter. Other effluent filters must be submitted to and approved by the JWSC.

The standpipe located at the interior partition shall extend above the liquid level and one-half (1/2) to two-thirds (2/3) down into the liquid level (the gray water area of the tank contents).

5.4.1.3 Tank Access

Tank access openings shall be provided in the tank top for routine maintenance and inspection. Access openings shall be properly located over the inlet tee and outlet filter. Manhole frames and covers shall be manufactured from ductile iron in accordance with ISO 1083, rated at H20 loading capable of one-man operation using standard tools. Covers shall be designed and maintained to prevent water inflow.

If required access tubes or risers shall be high density polyethylene (HDPE) pipe conforming to ASTM D1248 (Type III C, Category 5, P34) or precast concrete sealed as specified in Paragraph 5.4.1.1 above.

5.4.1.4 Sample Port

A sample port shall be provided outside and downstream of the tank outlet. The sample port shall consist of a six (6) inch by six (6) inch cross with the bottom of the cross extending a minimum of ten (10) inches below the invert of the outlet pipe. The sample port shall be housed in a cast iron valve box with lid.

5.4.1.5 Acceptable Manufacturers

The following manufacturers of sealed precast concrete tanks have been approved for use by the JWSC:

Bartow Precast Concrete
Hanson Pipe and Precast
Southern Precast Concrete

Other manufacturers must be submitted to and approved by the JWSC.

5.4.2 Pre-engineered Grease Interceptors

5.4.2.1 Construction

Pre-engineered grease interceptors shall be of steel or fiberglass construction in accordance with the manufacturer's standard fabrication procedures. Steel tanks shall be adequately protected against corrosion.

The interceptor shall be constructed to minimize turbulence, promote separation and settling and prevent re-suspension and scouring of collected materials. Temporary backwater conditions will not cause trapped contaminants to be scoured from the unit. Each unit shall be comprised of two cells or chambers, providing integral baffling. Wastewater shall enter below the normal liquid level and each unit shall be provided with an inlet and outlet cleanout, sample and ventilation ports together with an extension collar and frame and cover to allow access for removal of grease and solids. Each interceptor shall be installed in accordance with the manufacturer's instructions.

5.4.2.2 Acceptable Manufacturers

The following manufacturers of pre-engineered grease interceptors have been approved for use by the JWSC:

Highland Tanks, HT-PGI Triple Basin
LF Manufacturing, two chamber fiberglass tank
Proceptor, two chamber fiberglass tank

Other manufacturers must be submitted to and approved by the JWSC.

5.4.3 Pre-engineered Oil and Sand Separators

5.4.3.1 Construction

Pre-engineered oil and sand separators shall be of steel or fiberglass construction in accordance with the manufacturer's standard fabrication procedures. Steel tanks shall be adequately protected against corrosion.

The separator shall be constructed to minimize turbulence, promote separation and settling and prevent re-suspension and scouring of collected materials. Temporary backwater conditions will not cause trapped contaminants to be scoured from the unit. Each unit shall be comprised of two cells or chambers, providing integral baffling. Wastewater shall enter below the normal liquid level and each unit shall be provided with an inlet and outlet cleanout, sample and ventilation ports together with an extension collar and frame and cover to allow access for removal of oil and solids. Each separator shall be installed in accordance with the manufacturer's instructions.

5.4.3.2 Acceptable Manufacturers

The following manufacturers of pre-engineered oil and sand separators have been approved for use by the JWSC:

Highland Tanks, HT-PGI Triple Basin
LF Manufacturing, two chamber fiberglass tank
Proceptor, two chamber fiberglass tank

Other manufacturers must be submitted to and approved by the JWSC.

APPENDIX 5A
STANDARD CONSTRUCTION DETAILS

**COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BRUNSWICK, GA
BR-82-2001**



**COLLEGE *of*
COASTAL
GEORGIA**

**GEOTECHNICAL REPORT
PERMIT SUBMITTAL
APRIL 2024**

HUSSEY GAY BELL

Established 1958

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Geotechnical Engineering Report

Proposed New Performing Arts Center

College of Coastal Georgia

Mariner Way, Brunswick, Georgia

May 2, 2023

Project No. 05-02-23-6

Prepared For:

**Hussey Gay Bell
Savannah, Georgia**

Prepared By:

**Whitaker Laboratory, Inc.
Savannah, Georgia**



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May 2, 2023

Hussey Gay Bell
329 Commercial Drive
Savannah, GA 31406

Attention: Mr. Robert Armstrong
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M: (912) 667-2476

Referencing: Report of Geotechnical Evaluation Services for
Proposed New Performing Art Center
College of Coastal Georgia
Mariner Way, Brunswick, Georgia
Project No. 05-02-23-6

Dear Mr. Armstrong:

As requested, WHITAKER LABORATORY, INC. has conducted a geotechnical evaluation at the above referenced site. Authorization to perform this evaluation was provided by your acceptance of our proposal dated January 30, 2023. Our findings and recommendations for design and construction are attached and it is important that you read the report in its entirety.

It is a pleasure to provide our services to you and we look forward to further opportunities to assist you on this and other projects.

Respectfully submitted,
WHITAKER LABORATORY, INC.

A handwritten signature in black ink, appearing to read "Jason H. Follo", is written over the typed name.

Jason H. Follo, P.E.
Chief Engineer
#31031



A handwritten signature in black ink, appearing to read "Blake L. Jones", is written over the typed name.

Blake L. Jones, P.E.
Project Engineer
#44657



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REPORT OF GEOTECHNICAL EVALUATION

**Proposed New Performing Art Center
College of Costal Georgia
Mariner Way, Brunswick, Georgia**

I. INTRODUCTION / SCOPE

WHITAKER LABORATORY, INC. has completed an evaluation of the surface and subsurface conditions at this site. The preliminary conditions found, and how those conditions could affect the design and construction of foundations for the structures planned, form the basis for this report. Regardless of the thoroughness of any geotechnical evaluation, there are limitations, and deviations from the conditions found in this evaluation could be subsequently disclosed. We recommend that this report be provided to all parties involved in the planned development to include but not necessarily limited to the Owner, Architect, Design Engineers, General Contractor and sub-contractors. Unanticipated circumstances often arise during sitework, earthwork and foundation construction. Accordingly, we recommend that our firm be retained to provide the construction surveillance, inspection, and testing on the project, thereby being readily available to assist in the evaluation of any conditions encountered that differ from those anticipated.

The site is located on Mariner Way at the College of Costal Georgia in Brunswick, Georgia. We understand a new Performing Art Center and associated pavement are planned for construction on this site. In an effort to evaluate subsurface soil conditions and their impact on the design and construction of the planned construction, a total of five cone penetration test (CPT) soundings and five standard penetration test (SPT) borings were performed. The soundings and borings were advanced within the planned construction areas extending to depths ranging from 4 to 69 feet below the ground surface.

Please note that this evaluation only applies to the foundations and pavements planned for construction. This evaluation does not apply to any future improvements, which may be made to the site. In particular, if at any time should additional fill be placed, adjacent to or nearby the structure referenced in this report, additional geotechnical borings and a follow up geotechnical analysis will be required. Standard billing rates will apply for this work.

II. EXECUTIVE SUMMARY

The following recommendations shall be considered a summary of the recommendations contained within this report and utilized as such. This report shall be read in its entirety.

- The encountered near surface soils can be made suitable for support of the structure utilizing shallow spread pier and/or strip footing foundations with slab-on-grade flooring if our foundation loading assumptions are not exceeded and the recommendations contained within this report are performed and verified during construction.

At any time, we will be glad to discuss the contents of this report. This includes insuring that you fully consider potential problems for design and construction procedures in respect to interpretations of the data.

III. PROJECT INFORMATION & DESCRIPTION

We have not been provided foundation loads for the new structure, however for the purpose of this report we will assume that foundation loads will not exceed 100 kips for columns and/or 5 kips per linear foot for walls. We will further assume that site grades will not be raised more than 3 ½ feet above existing ground surface elevations to achieve finished grade elevations for the ground surface and/or slabs-on-grade.

Item	Description
Proposed Improvements	New Performing Art Center
Finished grade elevation for ground surface and/or slabs-on-grade	Assume maximum 3 ½ feet above existing grade.
Maximum Foundation loads	100 kips for columns and 5 kips per linear foot for walls
Maximum Floor Loads for slabs-on-grade	Assume 100 pounds per square foot
Maximum allowable settlement	Assume 1 inch overall and ½ inch differential
Above information was assumed by Whitaker Laboratory, Inc.	

If our understanding of the project or assumptions made are incorrect, we should be contacted immediately, provided the correct information and allowed an opportunity to change and/or modify the recommendations contained within this report if necessary.

IV. SITE LOCATION & DESCRIPTION

Item	Description
Location	Mariner Way, College of Costal Georgia, Brunswick, Georgia
Existing Structures	None within planned construction area
Current ground cover	Planned construction area resided within an open grassed area containing intermittent trees
Existing topography	Generally flat within the planned construction area

At the time of our site visit, the area consisted of an open grassed area with intermittent trees. Ground surface topography was generally flat within the planned construction areas. Boring locations were accessible and the near surface soils were stable to our truck mounted drilling equipment.

V. AREA GEOLOGY

This project is located in Brunswick, Georgia. This overall project area resides along the eastern edge of the South Atlantic Coastal Plain. In South Carolina and Georgia, this broad, gently sloping region extends southeastward from the Fall Line (Chesterfield - Columbia - Augusta - Macon - Columbus) to the Atlantic Ocean. The soils encountered are sedimentary in origin, and consist of layered marine deposits of sands, silts, and clays. These deposits have since been subjected to successive erosion and re-deposition, by fluctuations of sea levels, storm tides, and winds. Many of the surface sands are the result of depositional forces along ancient beaches, which formed during the changing shoreline and river conditions. Intermittent deposits of shells occur within the strata at irregular intervals. The surface soils in a majority of this Coastal Plain area were deposited during the Pleistocene Era, however surface soils near the coast are likely of the Holocene Era.

VI. TEST BORINGS AND SUBSURFACE CONDITIONS

The field exploration to determine the characteristics of the subsurface materials included a reconnaissance of the project site, the drilling of exploratory borings and the advancement of an electronic cone penetrometer.

Standard penetration test borings are performed using rotary head drilling equipment and advancing hollow stem augers. Sampling and Standard Penetration Testing, (SPT), was performed in accordance with ASTM D-1586. SPT samples were taken at 2.5-foot intervals of depth for the first 10 feet, and at 5.0-foot intervals thereafter. Standard Penetration Testing is done with a 140-pound hammer falling 30 inches and a 2-inch diameter sampling spoon.

The electric cone penetrometer is utilized to perform Cone Penetration Testing (CPT). An electric cone attached to the end of a series of rods is pushed into the ground at a constant rate and nearly continuous measurements are made of the resistance to penetration on the cone. Load cells (bonded strain gauges) build inside the electronic cone record end bearing, q_c , and friction sleeve stress, f_s as the cone is being pushed into the ground.

Both the Cone Penetration Test (CPT), and the results of the Standard Penetration Testing (SPT N values) provide an indication of the relative consistency, density and in-situ strengths of the tested soils.

Soil samples from SPT testing and from the auger cuttings have been used for identification and visual classification. The subsurface stratification and the profile as presented in the boring logs, represent approximate boundary lines between the strata and materials encountered. These boundary lines are usually gradual and not clearly defined, and it is sometimes difficult to record changes in stratification precisely. It should be noted that underlying soil conditions can, and do, vary considerably within short lateral distances. It is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis.

Soil behavior types identified within CPT logs are generated from the data collected during the CPT test and are based upon the soil classification chart for standard electronic friction cone (adopted from Robertson and Campanella UBC - 1983). The chart can be viewed within Appendix IV of this report.

The approximate locations of SPT borings and CPT tests are shown on the attached BORING LOCATION PLAN. Our field crews based on landmarks and features available at the time of work have estimated the test locations in the field. If the precise test locations are critical, this can be determined by employing a land-surveying firm to plot the true locations. Such survey should be completed promptly and before any disturbance to the area has occurred. If desired, WHITAKER LABORATORY, INC. will be glad to coordinate surveying arrangements for an additional fee.

Below approximately 3 to 8 inches of organic topsoil, the near surface soils on this site predominately consist of loose to dense sands and silty sands extending to the termination depth of the deepest sounding at 69 feet below the ground surface. Please note that firm clays were encountered bracketing elevations 50 to 67 feet below existing grades.

The above description of the subsurface profile should be considered a general description intended to highlight the major strata encountered. More detailed profiles can be observed within the attached logs. Please note that boring logs are only representative of their location. Stratification transitions should be expected to occur outside and between boring locations. Taking into account that sampling was not performed on a continuous basis within SPT borings, lines drawn representing elevations of stratification changes shown on the SPT boring log were estimated.

VII. GROUNDWATER TABLE

The groundwater elevation can be expected to fluctuate with the season of the year, surrounding ground surface conditions, and with recent rainfall amounts. Thus, approximate groundwater elevations shown on the CPT logs should be considered only for the time and date of observation. Pore water pressure measurements from CPT testing indicate groundwater resided approximately 5 feet below existing grades at the time of testing.

WHITAKER LABORATORY, INC. recommends that the contractor determine a groundwater level just prior to site work begins. We have addressed groundwater concerns within the Earthwork and Foundation Design Considerations section of this report.

VIII. SEISMIC SITE CLASSIFICATION AND COEFFICIENTS

Liquefaction Potential:

The design earthquake utilized in our analysis (Charleston, SC earthquake with magnitude 7.3 and a 2% probability of exceedance in 50 years) yielded peak horizontal ground surface accelerations of 0.13g on this site. Based upon the design earthquake and characteristics of subsurface soils, the liquefaction analysis indicated that the encountered sand stratifications present below the groundwater table do not have potential to liquefy during the design seismic event. Therefore, liquefaction induced settlements should not be of concern to the design of the structure.

International Building Code:

Assuming the structure has a period of vibration under 0.5 second and disregarding liquefaction potential, this site would be defined as a Site Class "D". The classification is determined by average soil properties in the top 100 feet of the soil profile, including standard penetration test N values, shear wave velocities, in-situ shear strengths and moisture contents, as specified by IBC 2018 / ASCE 7-16.

$$\begin{aligned}S_s &= 0.160 \\S_1 &= 0.074 \\S_{MS} &= 0.257 \\S_{M1} &= 0.176 \\S_{DS} &= 0.171 \\S_{D1} &= 0.118\end{aligned}$$

A summary report is attached in Appendix III of this report. If the period of vibration for the planned structure is in excess of 0.5 second or the size and design of this structure justifies additional investigation, a Site-Specific Geotechnical Investigation and dynamic site response analysis shall be performed. Our firm has the ability to provide our clients such testing and evaluation, and we will be available to discuss the cost, and potential benefit, if any, of such if you desire.

IX. EARTHWORK AND FOUNDATION DESIGN CONSIDERATIONS

The encountered near surface soils can be made suitable for support of the structure utilizing shallow spread pier and/or strip footing foundations with slab-on-grade flooring if our foundation loading assumptions are not exceeded and the recommendations contained within this report are performed and verified during construction.

Earthwork:

- We recommend that the building areas plus a minimum of 10 feet beyond the perimeter of all structural areas be stripped of any organics, stumps, roots, pavement sections, and unsuitable organic surface soils. Stripping depths will likely require extending to depths reaching 3 to 8 inches or more below existing grades to remove all unsuitable surface organic topsoil.
- After stripping, all exposed subgrade soils shall be thoroughly compacted in-place to 95% of ASTM-D-1557 and pass proof-rolling inspections prior to proceeding with backfill/fill placement. Areas found to pump or deflect should be undercut to a competent material and backfilled with an approved compacted material.
- Compaction efforts on exposed subgrade soils shall be made with a large vibratory smooth drum roller (Cat CS 74 or equivalent - centrifugal force range of 37,300 – 74,600 lb).
- All exposed subgrade soils shall be inspected, tested and approved by Whitaker Laboratory personnel prior to backfilling/filling placement begins.

- Backfill and fill material should consist of granular soils and meet the requirements for material type and placement as outlined within the SITE WORK RECOMMENDATIONS section of this report.
- **All fill shall be placed first, prior to foundation construction beginning.**

Foundations:

Once the above is accomplished, footings can be excavated. Bottom of footing excavations should be thoroughly compacted to meet or exceed 95% of the soils modified proctor maximum dry density in accordance with ASTM-D-1557.

Footing inspections shall be conducted by performing dynamic cone penetrometer (DCP) testing within hand auger holes within bottom of footing excavations to verify adequate bearing material is present. DCP testing shall be performed to depths reaching 3 feet below bottom of footing elevations and shall be performed at every building corner, every column footing and every 30 LF of strip footing. Subsurface bearing soils deemed unsuitable based upon visual classification and/or dynamic cone penetrometer testing should be undercut to a competent material and backfilled with an approved compacted material.

After the above is completed and verified by Whitaker personnel during construction, footings may be designed for safe soil bearing pressures of 2,500 PSF. Our technicians, prior to placing steel and concrete, should approve all footing excavations. All footings should have minimum plan dimensions of 18 inches. Bearing edges of slabs-on-grade should be a minimum of 18 inches wide. Footings and/or bearing edges of slabs-on-grade should reside at least 12 inches below finished grade elevations and a maximum of 3 feet below existing grades. Regardless, bearing elevations for spread footings shall meet local building code requirements for depth below finished grade.

Overall settlements on the order of one inch should be anticipated. Differential settlement is anticipated to be on the order of ½ the overall settlement. Floor slabs can be designed utilizing a modulus of subgrade reaction "k" value of 150 pci.

Lateral loads can be resisted by passive earth pressure due to compacted structural fill placed against the sides of the footings. The upper 1-foot of resistance should be neglected unless the fill is confined by a pavement or floor slab. A soil unit weight of 110 pcf and passive earth pressure coefficient of 3.0 can be utilized in the analysis. Additionally, a friction coefficient of 0.35 between the concrete footings and underlying soil can be used in combination with passive earth pressures to resist lateral loads. The coefficient of friction should be applied to dead normal loads only.

Groundwater:

Please note that the groundwater table was encountered as shallow as 5 feet below the ground surface within the borings. If excavations extend more than 3 feet below existing grades, temporary dewatering may be required. Typically, the groundwater level needs to be 24 inches below subgrade elevations to properly compact the subgrade and subsequent backfill materials. Although dewatering techniques consisting of well point systems, sump pits with pumps, and/or drainage ditches are typically effective methods to lower groundwater, the means and methods for dewatering should ultimately be the responsibility of the contractor.

X. SITE WORK RECOMMENDATIONS

We will be pleased to discuss these recommendations with the owner and the site work contractor selected to do the work. We believe it will be beneficial to the project, for the owner and the contractor to have a clear understanding of our recommendations.

1. Prior to construction, all building areas, plus at least 10 feet on each side and all areas to be paved, should be stripped of all vegetation, topsoil and root systems. Site drainage during construction should be considered prior to this clearing and stripping. Preventing the ponding of storm water is of particular importance.
2. Topsoil, organics, root-mat and other surface materials will likely vary across the site. Individual test borings may not accurately reflect the presence of, or the thickness of such materials due to site variability and/or surfacing clearing to facilitate access for drilling equipment. Site clearing and grubbing, when unsupervised, and particularly in areas of wet soils and times of wet weather, may push organic debris into otherwise stable soils. Undercutting and clearing with a track hoe in lieu of bulldozers can minimize this.
3. Any stump holes or other depressions should be cleared of loose material and debris, and should then be back-filled with approved fill. The backfill should be placed in 6-inch thick lifts and compacted to 95% density in accordance with ASTM D-1557.
4. Any existing utilities that underlie the site should be relocated and their trenches back-filled with approved soil. The backfill should be placed in 6-inch lifts and compacted to 95% density according to ASTM D-1557.

5. Prior to fill placement, the subgrade should be proof rolled with a loaded dump truck to locate unstable or soft areas. Any unstable areas should then be investigated to determine the cause of the instability. If due to unsuitable soils, such as highly organic soils or soft clays, the areas should be undercut to firm soil and replaced with approved fill compacted in 6-inch lifts to minimum density of 95% in accordance with ASTM D-1557. If the instability is due to excess moisture in otherwise stable soil, the area should be drained and compacted to 95% density.
6. Any fill or backfill required to level or raise the site should be placed in 8 to 10 inch thick, loose lifts and compacted by appropriate compaction equipment to 95% density in accordance with ASTM D-1557.
7. All of the fill and backfill (including utility line backfill) for this project should consist of clean, free draining granular soils. The fill should be free of objectionable roots, clay lumps, organics and other debris. The fill should be readily compactable during placement. Soils classified as SW, SP, SP-SM or SM with a maximum of 15% passing a #200 sieve may be acceptable. Soils with the minus #200 fraction classified as MH, CH, OH, ML, CL or SC may be rejected. Soils with a maximum plasticity index of 25 and a maximum liquid limit 40 may be acceptable for use only beneath building pads which are situated well above the groundwater table with approval from the geotechnical engineer. Soils classified as SC or CL, exhibiting moisture sensitivity, soils with excessive clay content, or excessive moisture should not be used without approval from the geotechnical engineer. Approved sands will also need to be moisture conditioned as necessary to facilitate proper compaction throughout its entire depth. If utility trenches cannot be sufficiently dewatered to readily allow compaction of the specified pipe bedding material, then a class I (ASTM-D-2321) gravel or gravel mixture will be required.
8. To assist in reducing moisture beneath the structure, and to reduce the potential for mold growth, the site shall be graded and filled as necessary to direct drainage away from the structure. If sub drains are installed, these alone may not prevent moisture vapor beneath the structure that can cause mold growth. (Also refer to paragraph 10 below). Care must be taken to not place concrete on top of wet soils. For example, if fill or natural soils experience heavy rain, the soils should be properly drained and dried, prior to placement of concrete. Otherwise moisture migration through the slab will occur.

9. Compact all footing excavations and slab subgrades to a minimum density of 95% in accordance with ASTM-D-1557, prior to placement on concrete. The footing excavations, and all prepared slab subgrade, should be maintained in a dry and compacted condition until the concrete is placed. Areas that are softened by water or that are disturbed by construction activity should be re-worked, re-compacted, or appropriately repaired to the required bearing and density. If necessary, stone backfill or other corrective measures may be implemented to stabilize footings.
10. All slabs-on-grade should be supported on a minimum of 4-inches of granular, free-draining gravel or coarse sand to reduce moisture migration by capillarity. A vapor retarding membrane, overlying this granular base, is recommended to further reduce moisture migration into finished areas of the structure. Note that the use of these measures will not totally prevent moisture under or on top of slabs or beneath structures. (Also refer to paragraph 8 above).
11. Any footing excavations that are directly adjacent to the existing foundations should be done in small increments to avoid undermining them and causing a loss of support to the existing structure. If necessary, the excavations should be sheeted and braced or grouting should stabilize the soil in the immediate area.

XI. PAVEMENT RECOMMENDATIONS

Subgrade for driveways and parking areas should consist of a minimum of 24-inches of clean sand subgrade compacted to a density of 95% of its maximum dry density as determined by ASTM-D-1557. Pavement designs should also provide a minimum of 24-inches separation between the bottom of the base course material and the seasonal high ground water table. Undercutting, re-compacting, and/or replacing of existing surface soils will be required unless subgrade consists of organic free, virgin sandy soils that are proven to be a minimum of 24-inches thick, 24-inches above the seasonal high ground water table, compacted to 95% of ASTM D-1557 and passes a proof-roll. Final grades and elevations will determine the extent of any filling, undercutting and backfilling that may be required.

Due to near surface soils on this site consisting of sandy type soils, the in-situ sands can be made suitable as subgrade for pavements as long as the sandy subgrade soils are compacted for the full 24-inch depth below bottom of pavement section elevations. As stated above, Compaction efforts on exposed subgrade soils after stripping shall be made with a large vibratory smooth drum roller (Cat CS 74 or equivalent - centrifugal force range of 37,300 – 74,600 lb). Exposed subgrade soils shall be inspected, tested and approved by Whitaker Laboratory personnel prior to backfilling/filling placement begins and/or placement of aggregate base.

Due to groundwater residing 5 feet below existing grades on this site, the incorporation of under drains in the pavement design will not be required as long as bottom of pavement section elevations does not reside more than 24 inches below existing grades.

All proof rolling, construction observations, compaction testing of paved areas must be in accordance with the SITE WORK section above. If a rain event of 0.5 inches or more, occurs after initial proof rolling and prior to subsequent placement of base or surface wearing course, the proof roll testing must be repeated just prior to additional work.

The below recommended pavement sections should be considered standard and typical for the area. We have not been provided traffic data and/or been instructed to perform CBR testing on subgrade soils, therefore these pavement sections should not be considered a pavement design. The below recommended pavement sections are based upon the assumption that the sandy subgrade soils will yield a minimum CBR value of 8 if compacted to 95% ASTM D-1557 for a full 24-inch depth. In addition, the below recommended light duty pavement sections should be considered for car traffic areas only. Below recommended heavy duty sections should be utilized for all areas receiving truck traffic (delivery trucks and garbage trucks with 18-kip axle loads). In addition, the heavy-duty sections recommended below are for low volume truck traffic (15 to 20 trucks per day).

LIGHT DUTY PAVEMENT (CARS & LIGHT TRUCKS)

SUBGRADE: Minimum – 24-inches of drained, compacted, coarse grained soil
BASE COURSE: Minimum - 6-inches of Graded Aggregate Construction
SURFACE COURSE: Minimum - 2-inches of 12.5 mm Superpave

HEAVY DUTY PAVEMENT (LOADED TRUCKS WITH 18+ kip AXLE LOADS)

SUBGRADE: Minimum – 24 inches of drained, compacted, coarse grained soil
BASE COURSE: Minimum - 8-inches of Graded Aggregate Construction
BINDER COURSE: Minimum - 2-inches of 19 mm Superpave
SURFACE COURSE: Minimum - 2.0-inches of 9.5 mm Type II Superpave, or
Minimum - 2.0-inches of 12.5 mm Superpave

In all projects, a minimum mat temperature of 185° F must be maintained through final roller pass.

Please note that specifications for the above mentioned base course and surface course can be found under Sections 310, 400, 402, 815 and 828 of the Georgia Department of Transportation State of Georgia Standard Specifications Construction of Transportation Systems, 2001 Edition. The mix design must include "lime".

PORTLAND CEMENT CONCRETE PAVEMENT

SUBGRADE: Minimum – 24-inches of drained, compacted, coarse grained soil

HEAVY DUTY: 8 inches of Portland cement concrete with minimum compressive strength of 4000 psi.

LIGHT DUTY & RESIDENTIAL: 5 inches of Portland cement concrete with minimum compressive strength of 4000 psi

Whitaker Laboratory recommends incorporating a minimum of 4-inches of graded aggregate base course below the above concrete pavement sections for maintaining a smooth and level surface during placement of the pavement section.

Joints must be placed a MAXIMUM spacing in FEET of 2.5 times the pavement thickness in inches, and in no case more distant apart than 15 feet.

Pavement Design should include:

- Requirements to seal all pavement joints to prevent surface water entry into base / subgrade. Such provision should minimize pumping failures at joints.
- Requirements that pavement sections and panels subject to repetitive braking and/or acceleration should be designed with lug anchors or tie-bars to minimize separation or misalignment at the joints.
- Provisions for load transfer across construction joints by dowels or other acceptable means.
- In general, the design should follow the recommendations and practices for all components as described in ACI 330.1 and/or ACI 330R as applicable.

XII. QUALITY CONTROL AND TESTING

Documented inspections and/or testing performed by Whitaker Laboratory personnel, at the following critical milestones during construction, will be required for the recommendations contained within this report to be validated:

Earthwork:

- After site stripping: Perform density testing and proofrolling on exposed subgrade soil to verify exposed subgrade soils are compacted and stable enough to begin backfill and/or fill placement.
- Collect sample of proposed backfill/fill material, perform laboratory testing and determine suitability for use (approve or disapprove).
- During backfill/fill placement: Perform density testing on each lift of backfill and/or fill soil.
- Verify all fill is placed first, prior to foundation construction begins.

Footings:

- Once footings are excavated: Perform inspection on bearing subgrade soils within bottom of footing excavations prior to placement of reinforcing steel or concrete. DCP testing shall be performed to depths reaching 3 feet below bottom of footing elevations and shall be performed at every building corner, every column footing and every 30 LF of strip footing. Provide recommendations for undercutting and replacement where deemed necessary.

At the appropriate time, please contact Whitaker Laboratory, Inc. for budgetary and scheduling purposes for the performance of the above required inspection and testing services.

We further offer concrete, asphalt, masonry, and structural steel inspections and testing. Whitaker Laboratory, Inc. also performs observational services for mold mitigation, including observation of installation of vapor retarding membranes, subdrains, overall site drainage, and regularly scheduled observations after construction of site and landscape drainage, and monitoring of humidity and moisture in slabs and basement walls.

XIII. QUALIFICATIONS OF REPORT

Any recommendations or opinions offered in this report are based on our interpretation of the data obtained from this investigation. It should be noted that underlying subsurface and soil conditions can, and do, vary considerably within short lateral distances. Regardless of the thoroughness of any subsurface investigation, it is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis. For this reason, we recommend that the site preparation and foundation construction for this project be monitored closely. If deviations of the soil conditions from those presented in this report appear, we will be glad to furnish any additional analyses and recommendations that may be required.

This report was made to investigate subsurface properties of the site and is not intended to serve as a wetlands survey, toxic mold assessment, or environmental site assessment. No effort has been made to define, delineate, or designate any area as wetlands or an area of environmental concern or contamination. Any references to low areas, poorly drained areas, etc. are related to geotechnical applications. Any recommendations regarding drainage and earthwork are made on the basis that such work can be permitted and performed in accordance with the current laws pertaining to wetlands, storm water runoff, and environmental contamination.

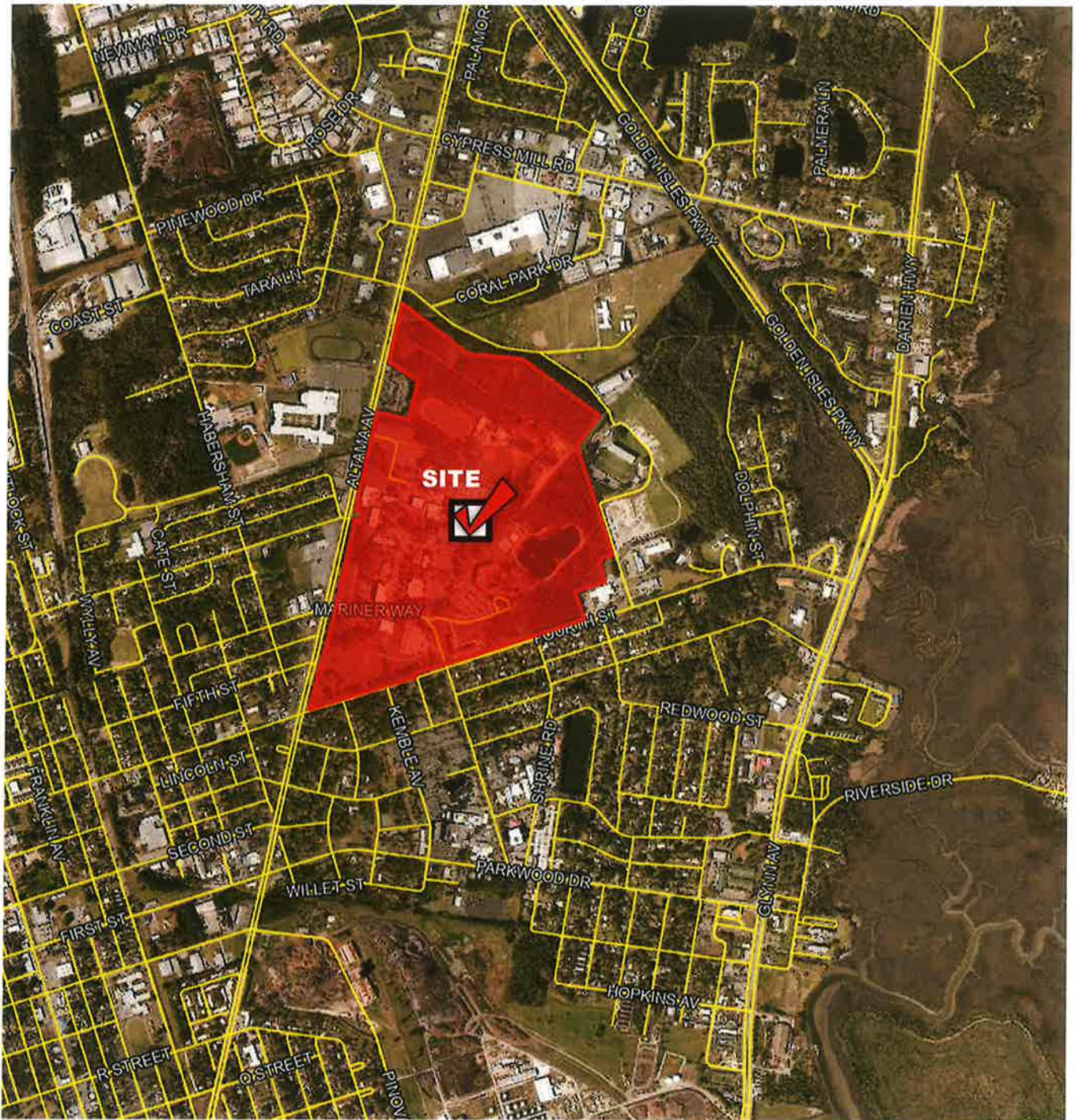
This report does not attempt to define or represent any FEMA, or otherwise designated, flood, erosion, scour, or other hazardous zones; nor does it presume to reflect that governmental or other authorities will grant approval of the project and issue appropriate permits.

WARRANT: WHITAKER LABORATORY, INC. and its professional engineers strive to perform all services in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession practicing in the same locality and under similar conditions. No other warranty or representation, expressed or implied, is included or intended in this agreement, in any report, opinion, document, or otherwise. We carry commercial general liability insurance, including completed operations, and professional liability insurance in aggregate amounts deemed adequate, and we comply with the statutory requirements for workmen's compensation insurance. Accordingly, by accepting and relying on the contents of this report, the liability of WHITAKER LABORATORY, INC. and its professional engineers, to the client, owner, or any other party, for any loss or damage, resulting from any cause, including professional acts, errors, omissions, negligence, toxic mold and other environmental claims, breach of warranty or breach of contract, shall not exceed the total compensation received by us for services related to this project; and client will defend, settle, and discharge any claims or allegations of liability for same against us by others.

If client desires higher monetary limits of our liability, we will be pleased to discuss such higher limits and the impact on liability and fees. In the event the client makes a claim against us, at law or otherwise, for any alleged act, error, omission, negligence, breach of warranty or breach of contract, arising from the performance of our services, it is mutually agreed that initially, the client and Whitaker Laboratory, Inc. will attempt to resolve such dispute through direct negotiations between the appropriate representatives of each party. Secondly, if such negotiations are not fully successful, the parties agree to resolve any remaining disputes by formal nonbinding arbitration mediation in accordance with the rules and procedures to be agreed upon by the parties. Mediation is a pre-condition to litigation. The exclusive venue for any disputes relating to Whitaker Laboratory's service shall be in Chatham County, GA. Furthermore, if the client fails to prove such claim, then client shall pay all costs accrued by us in defending ourselves.

TITLE: The ownership of opinions, technical ideas, methods and means, drawings, calculations, and other data developed by us during the course of preparing proposals or rendering engineering services remains exclusively with us. It is a condition of this report or proposal that the client agrees not to use the opinions, technical ideas, methods and means, drawings, calculations or any other data for projects or locations, other than those specifically addressed in the report, and that no one other than the client may use this report, without the written permission of WHITAKER LABORATORY, INC.

APPENDIX I
SITE VICINITY & BORING LOCATION PLANS



Site Vicinity Map

1 College Drive
Brunswick, Glynn County, Georgia



ALL BORING LOCATIONS ARE APPROXIMATE, & ARE BASED ONLY ON FIELD ESTIMATES.





Boring Location Plan

1 College Drive
Brunswick, Glynn County, Georgia



ALL BORING LOCATIONS ARE APPROXIMATE, & ARE BASED ONLY ON FIELD ESTIMATES.

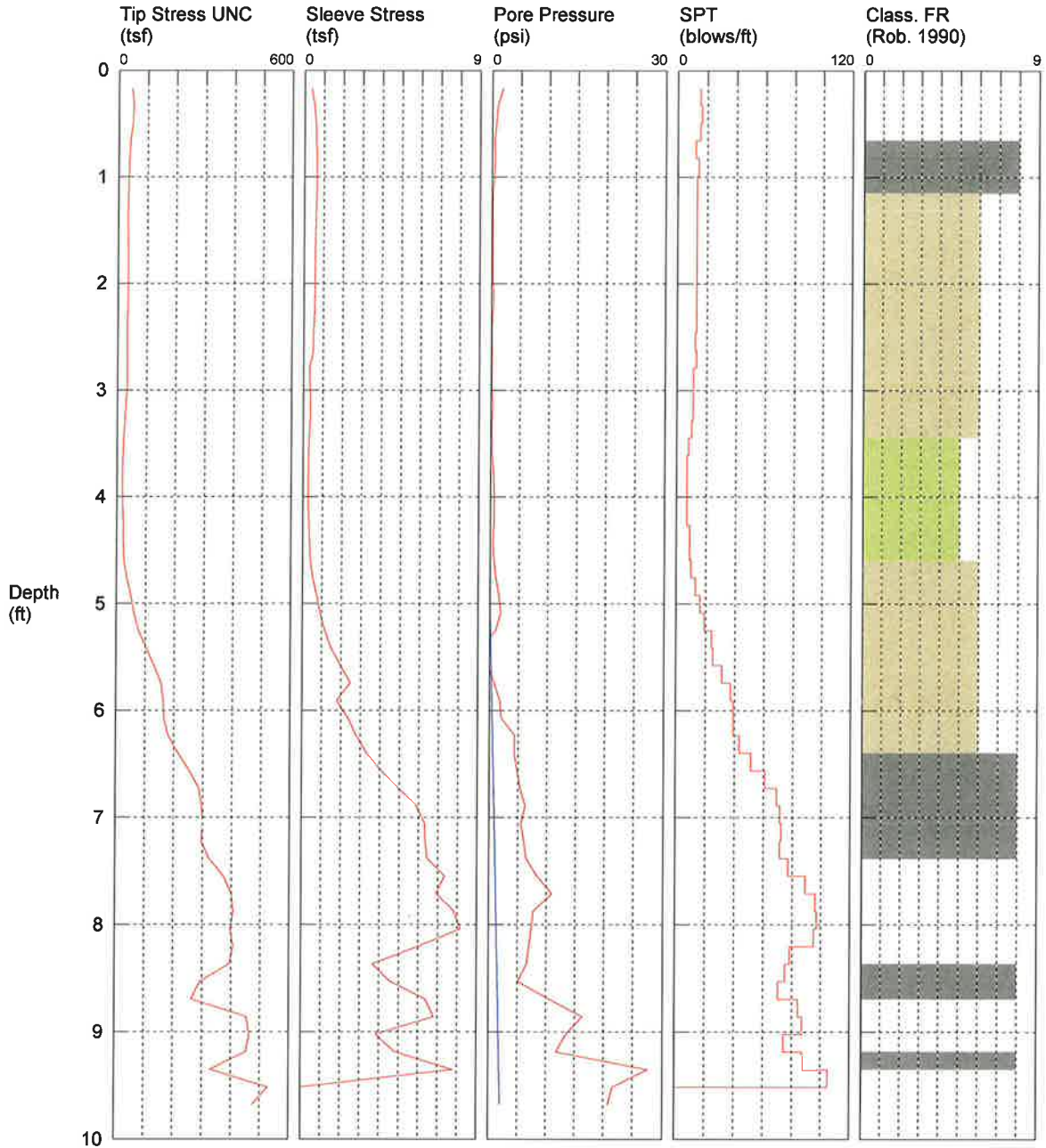


APPENDIX II
BORING RECORDS

CPT- 1

SOUNDING
 CUSTOMER: Customer
 OPERATOR: Kicklighter
 CONE ID: DDG1631
 LOCATION: Brunswick GA

JOB NUMBER: College of Coastal Georgia Per TOTAL DEPTH: 9.678 ft
 HOLE NUMBER: CPT- 1
 TEST DATE: 4/18/2023 11:12:45 AM
 SOUNDING



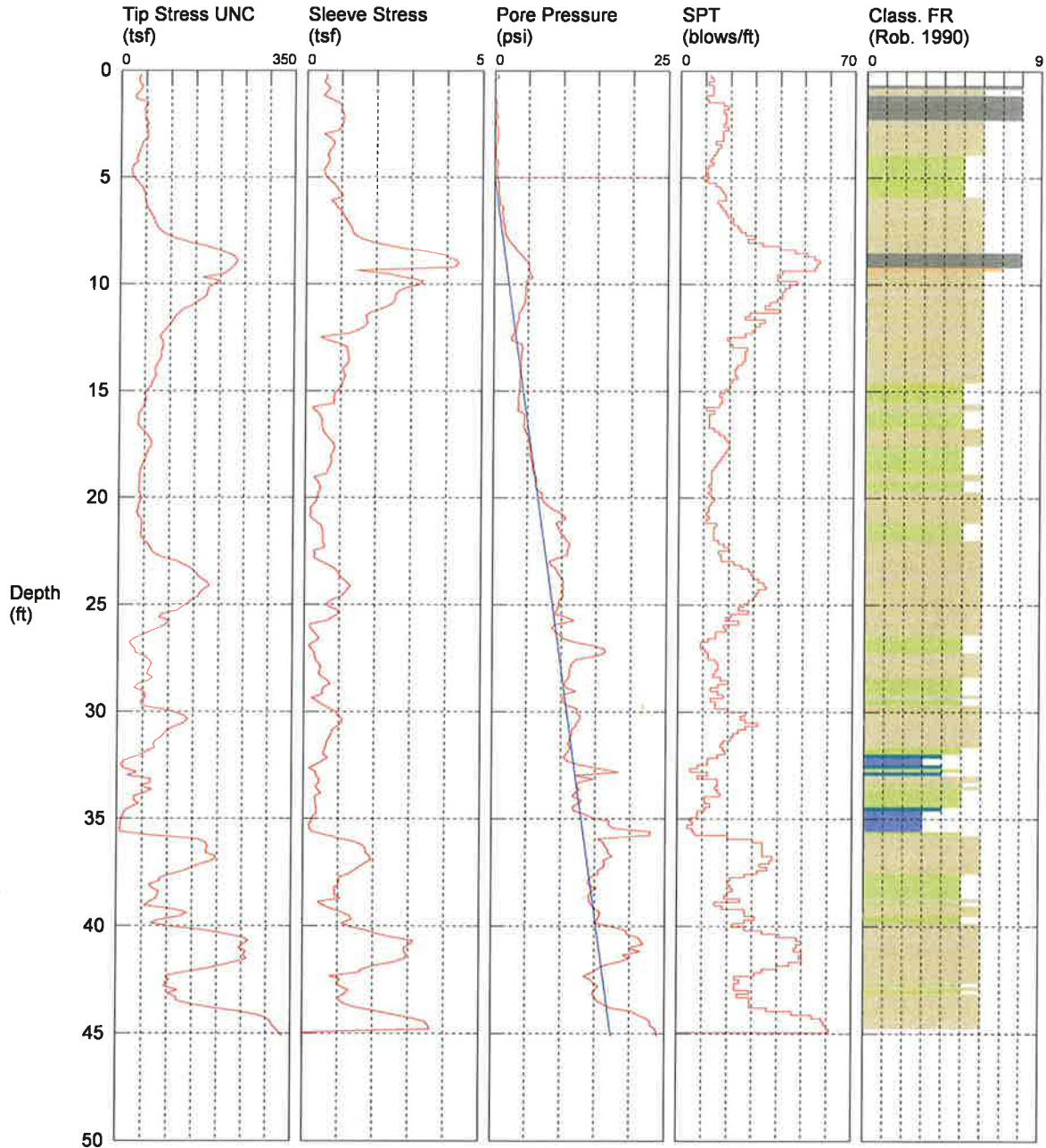
- | | | |
|------------------------------|--|-------------------------------------|
| 1 Sensitive, fine grained | 4 Silt mixtures - clayey silt to silty clay | 7 Gravelly sand to sand |
| 2 Organic soils - peats | 5 Sand mixtures - silty sand to sandy silty sand | 8 Very stiff sand to clayey sand ** |
| 3 Clays - clay to silty clay | 6 Sands - clean sand to silty sand | 9 Very stiff, fine grained ** |
- *SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT- 2

SOUNDING
 CUSTOMER: Customer
 OPERATOR: Kicklighter
 CONE ID: DDG1631
 LOCATION: Brunswick GA

JOB NUMBER: College of Coastal Georgia Performance
 HOLE NUMBER: CPT- 2
 TEST DATE: 4/18/2023 11:32:32 AM
 SOUNDING

TOTAL DEPTH: 45.112 ft



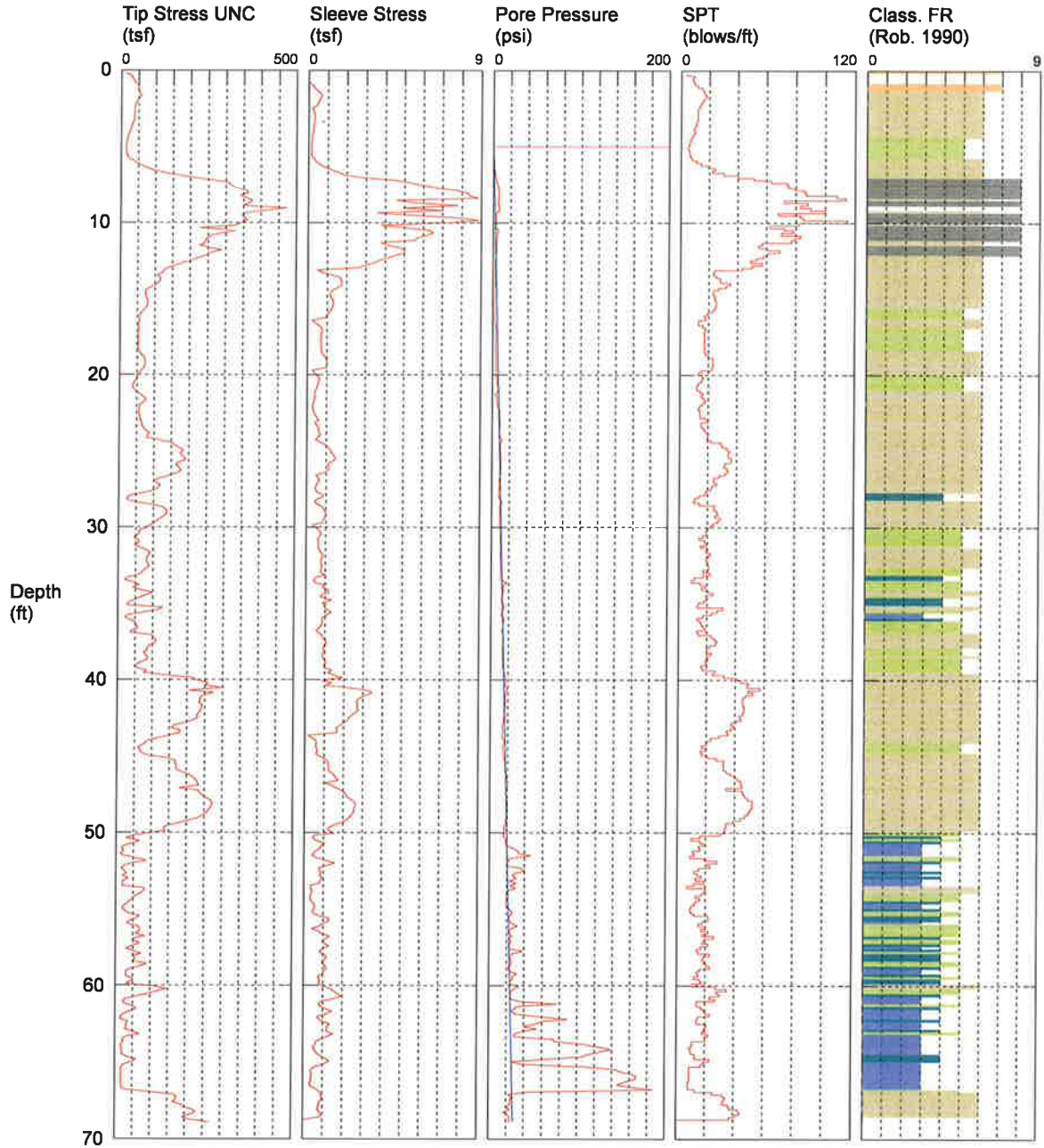
- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 1 Sensitive, fine grained 2 Organic soils - peats 3 Clays - clay to silty clay | <ul style="list-style-type: none"> 4 Silt mixtures - clayey silt to silty clay 5 Sand mixtures - silty sand to sandy silt 6 Sands - clean sand to silty sand | <ul style="list-style-type: none"> 7 Gravelly sand to sand 8 Very stiff sand to clayey sand ** 9 Very stiff, fine grained ** |
|--|---|---|

*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT- 3

SOUNDING
 CUSTOMER: Customer
 OPERATOR: Kicklighter
 CONE ID: DDG1631
 LOCATION: Brunswick GA

JOB NUMBER: College of Coastal Georgia Performance
 HOLE NUMBER: CPT- 3
 TEST DATE: 4/18/2023 12:19:12 PM
 SOUNDING
 TOTAL DEPTH: 68.898 ft



1 Sensitive, fine grained	4 Silt mixtures - clayey silt to silty clay	7 Gravelly sand to sand
2 Organic soils - peats	5 Sand mixtures - silty sand to sandy silt	8 Very stiff sand to clayey sand**
3 Clays - clay to silty clay	6 Sands - clean sand to silty sand	9 Very stiff, fine grained**

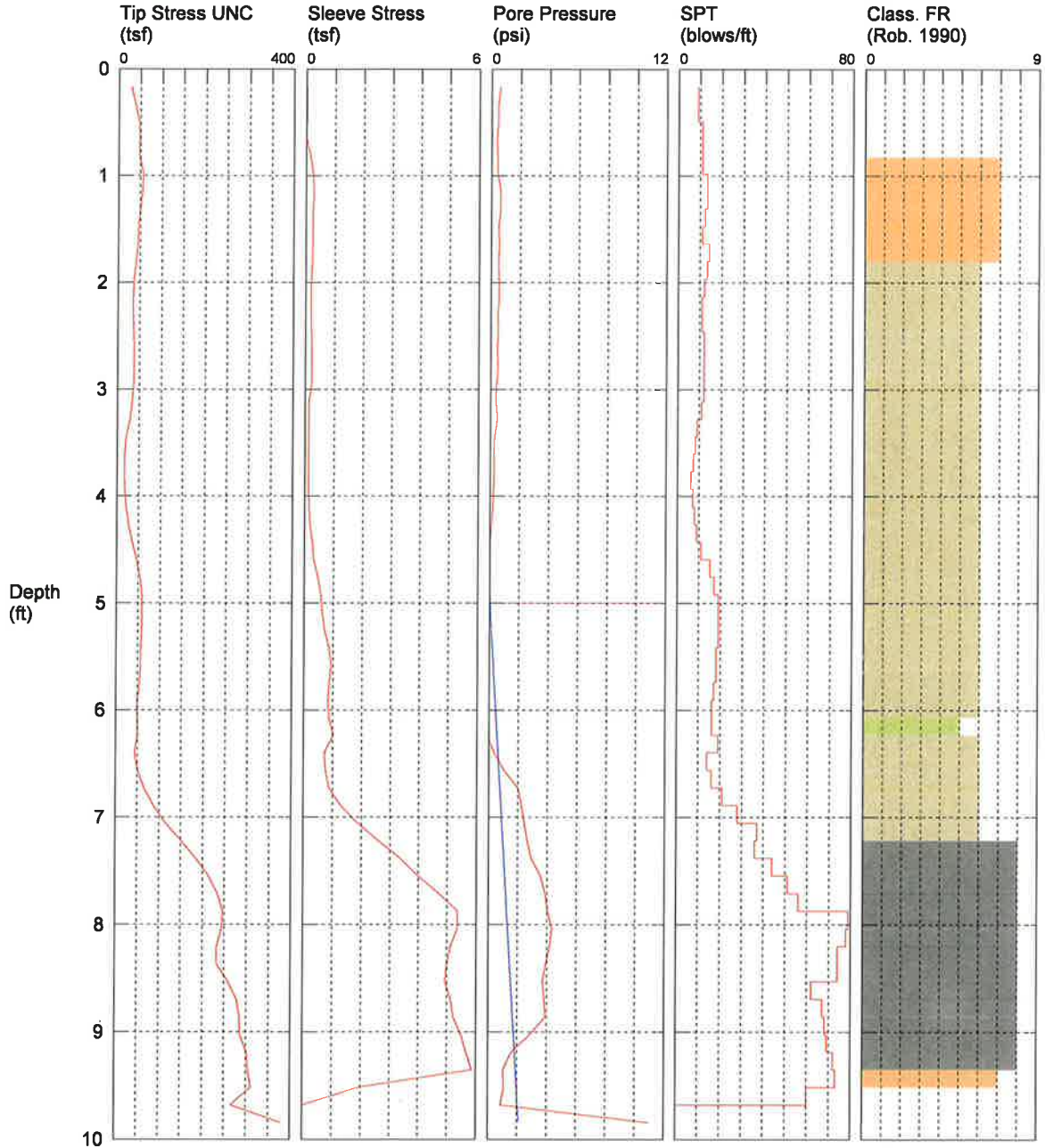
*SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT- 4

SOUNDING
 CUSTOMER: Customer
 OPERATOR: Kicklighter
 CONE ID: DDG1631
 LOCATION: Brunswick GA

JOB NUMBER: College of Coastal Georgia Performance
 HOLE NUMBER: CPT- 4
 TEST DATE: 4/18/2023 1:36:16 PM
 SOUNDING

TOTAL DEPTH: 9.843 ft



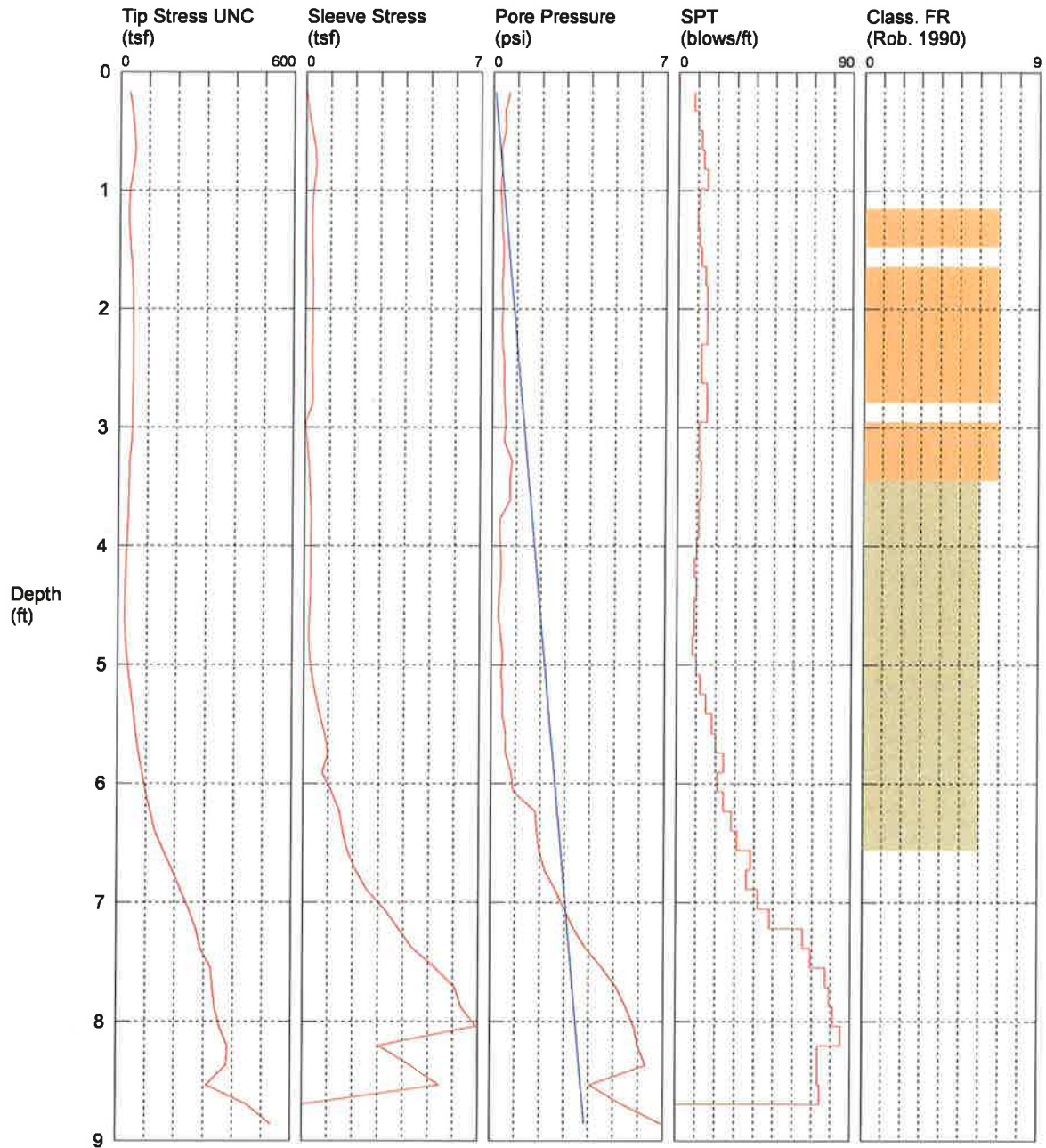
- | | | |
|------------------------------|---|-------------------------------------|
| 1 Sensitive, fine grained | 4 Silt mixtures - clayey silt to silty clay | 7 Gravelly sand to sand |
| 2 Organic soils - peats | 5 Sand mixtures - silty sand to sandy sil | 8 Very stiff sand to clayey sand ** |
| 3 Clays - clay to silty clay | 6 Sands - clean sand to silty sand | 9 Very stiff, fine grained ** |
- *SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

CPT- 5

SOUNDING
 CUSTOMER: Customer
 OPERATOR: Kicklighter
 CONE ID: DDG1631
 LOCATION: Brunswick GA

JOB NUMBER: College of Coastal Georgia Performance
 HOLE NUMBER: CPT- 5
 TEST DATE: 4/18/2023 1:52:36 PM
 SOUNDING

TOTAL DEPTH: 8.858 ft



- | | | |
|------------------------------|---|-------------------------------------|
| 1 Sensitive, fine grained | 4 Silt mixtures - clayey silt to silty clay | 7 Gravelly sand to sand |
| 2 Organic soils - peats | 5 Sand mixtures - silty sand to sandy silt | 8 Very stiff sand to clayey sand ** |
| 3 Clays - clay to silty clay | 6 Sands - clean sand to silty sand | 9 Very stiff, fine grained ** |
- *SBT: Robertson 1990; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

WHITAKER LABORATORY, INC.
P.O. BOX 7078
SAVANNAH, GEORGIA 31418

Project Name College of Coastal Georgia **Date** 4/18/2023

Project Location Mariner Way, Brunswick, Georgia

Boring Number _____ **Field Engineer** Lynn Mack (B-48)

Ground Surface Elevation _____ **Ground Water Elevation** _____

Sample No.	Sample		Stratum		Visual Field Classification	N-Count
	From	To	From	To		
B-1			0	8"	Topsoil	
			8"	24"	Firm Gray/Brown Fine Sand (SP-SM)	-1' - 12
			24"	48"	Firm Tan/Brown Fine Sand (SP-SM)	-3' - 14
					Groundwater not Encountered	
B-2			0	10"	Topsoil	-1' - 17
			10"	48"	Firm Tan/Brown Fine Sand (SP-SM)	-3' - 14
					Groundwater not Encountered	
B-3			0	7"	Topsoil	-1' - 12
			7"	18"	Firm Tan Fine Sand (SP-SM)	-3' - 17
			18"	36"	Firm Tan/Brown Fine Sand (SP-SM)	
			36"	48"	Firm Tan Fine Sand (SP-SM)	
				Groundwater not Encountered		
B-4			0	8"	Topsoil	-1' - 9
			8"	18"	Loose Gray/Brown Fine Sand (SP-SM)	-3' - 10
			18"	42"	Loose to Firm Tan/Orange Fine Sand (SP-SM)	
			42"	48"	Firm Tan/Brown Fine Sand (SP-SM)	
				Groundwater not Encountered		
B-5			0	4"	Topsoil	-1' - 9
			4"	18"	Loose Gray Fine Sand (SP-SM)	-3' - 7
			18"	48"	Loose Tan/Brown Fine Sand (SP-SM)	
				Groundwater not Encountered		

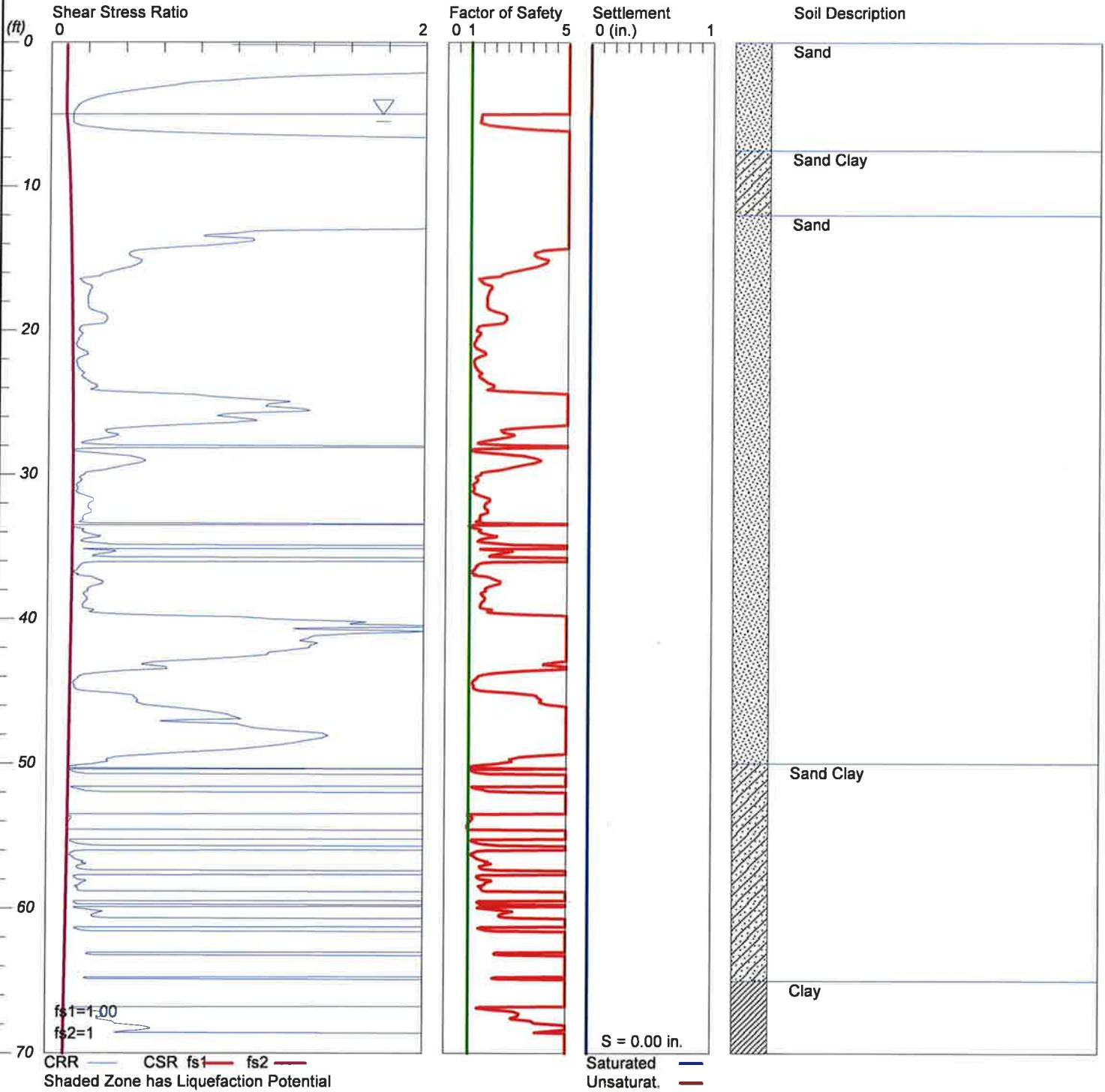
APPENDIX III
SEISMIC PARAMETERS

LIQUEFACTION ANALYSIS

1 College Drive

Hole No.=CPT-3 Water Depth=5 ft
Ground Improvement of Fill=2 ft

Magnitude=7.3
Acceleration=0.13g



LiquefyPro CivilTech Software USA www.civilttech.com



1 College Drive, Brunswick, GA

Latitude, Longitude: 31.1802, -81.4881



Map data ©2023

Date	4/29/2023, 10:04:43 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.16	MCE_R ground motion. (for 0.2 second period)
S_1	0.074	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.257	Site-modified spectral acceleration value
S_{M1}	0.176	Site-modified spectral acceleration value
S_{DS}	0.171	Numeric seismic design value at 0.2 second SA
S_{D1}	0.118	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.081	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.129	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
$SsRT$	0.16	Probabilistic risk-targeted ground motion. (0.2 second)
$SsUH$	0.183	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
$S1RT$	0.074	Probabilistic risk-targeted ground motion. (1.0 second)
$S1UH$	0.084	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
$S1D$	0.6	Factored deterministic acceleration value. (1.0 second)
$PGAd$	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.081	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.878	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.878	Mapped value of the risk coefficient at a period of 1 s
C_V	0.7	Vertical coefficient

DISCLAIMER

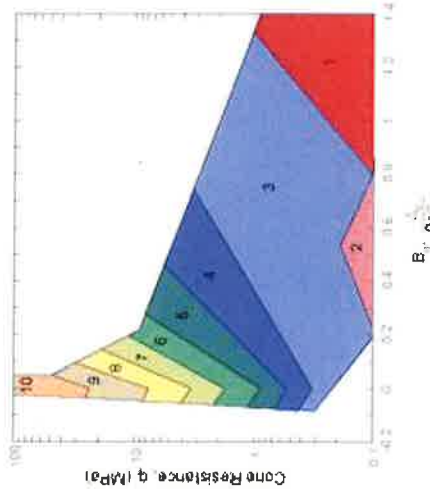
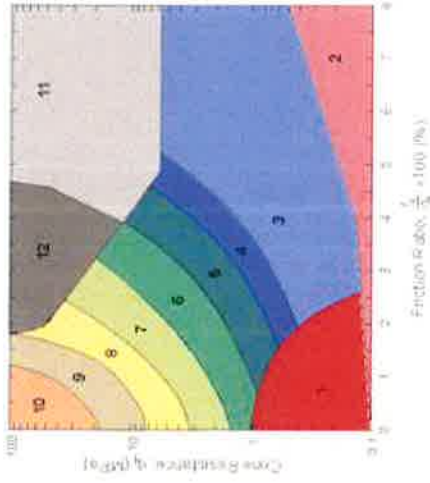
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APPENDIX IV

IMPORTANT GENERAL NOTES

CPT Soil Behavior Type Legend

Robertson et al. 1986

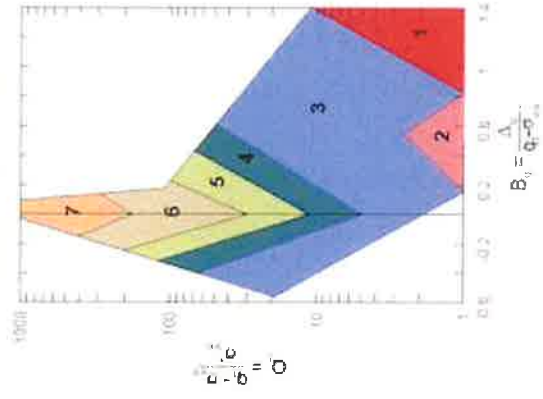
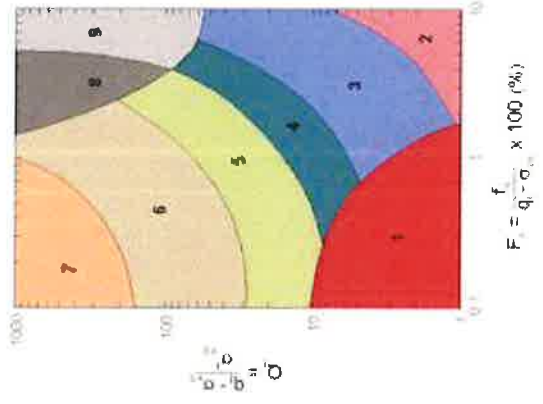


Soil Behavior Type

Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Material
3	Clay
4	Silty Clay to Clay
5	Clayey Silt to Silty Clay
6	Sandy Silt to Clayey Silt
7	Silty Sand to Sandy Silt
8	Sand to Silty Sand
9	Sand
10	Gravelly Sand to Sand
11	Very Stiff Fine Grained*
12	Sand to Clayey Sand*

*Overconsolidated or Cemented

Robertson et al. 1990



Soil Behavior Type

Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Soils- Peats
3	Clays: Clay to Silty Clay
4	Silt Mixtures: Clayey Silt to Silty Clay
5	Sand Mixtures: Silty Sand to Sandy Silt
6	Sands: Clean Sands to Silty Sands
7	Gravelly Sand to Sand
8	Very Stiff Sand to Clayey Sand*
9	Very Stiff Fine Grained*

*Overconsolidated or Cemented

GENERAL NOTES

The "standard" penetration resistance is an indication of the density of cohesion less soils and of the strength of cohesive soils. The "standard" penetration test is measured with a 1.4 inch I.D., 2 inch O.D., sampler driven one (1) foot with a 140 pound hammer falling 30 inches.

RELATIVE DENSITY OF SOIL THAT IS PRIMARILY SAND

Number of Blows	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 20	Firm
21 - 30	Very firm
31 - 50	Dense
Over 51	Very dense

CONSISTENCY OF SOIL THAT IS PRIMARILY SILT OR CLAY

Number of Blows	Consistency
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very stiff
Over 31	Hard

While individual test boring records are considered to be representative of subsurface conditions at the respective boring locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

The subsoil stratification shown on these profiles is not warranted but is estimated based on accepted soil engineering principles and practices and reasonable engineering judgment.

Unless notified, samples will be disposed of after 60 days.

GROUP

MAJOR DIVISIONS SYMBOLS TYPICAL NAMES

COARSE-GRAINED SOILS

More than 50% retained on No. 200 Sieve*

GRAVELS

50% or more of coarse fraction retained on No. 4 sieve

CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silty mixtures
	GC	Clayey gravels, gravel sand clay mixtures

SANDS

More than 50% of coarse fraction passes No. 4 sieve

CLEAN SANDS	SW	Well graded sand and gravelly sands, little or no fines
	SP	Poor graded sands and gravelly sands, little or no fines
SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand clay mixtures

FINE GRAINED SOILS

50% or more passes No. 200 Sieve*

SILTS AND CLAYS

Liquid Limit 50% or less

ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
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 sands or silts, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity

HIGHLY

ORGANIC SOILS

PT	Peat, muck and other highly organic soils
----	---

*Based on the material passing the 3 in. (75 mm) sieve.

**COLLEGE OF COASTAL GEORGIA
COASTAL COMMUNITY CENTER FOR THE ARTS
BRUNSWICK, GA
BR-82-2001**



**COLLEGE *of*
COASTAL
GEORGIA**

**SCHEDULE OF SPECIAL INSPECTIONS
PERMIT SUBMITTAL
PERMIT 2024**

HUSSEY GAY BELL

Established 1958

**HUSSEY, GAY, BELL & DEYOUNG INTERNATIONAL, INC.
ENGINEERS & ARCHITECTS**

329 Commercial Drive, Suite 200

Savannah, Georgia 31406

Phone: (912) 354-4626 Fax: (912) 354-6754

www.husseygaybell.com

STATEMENT OF SPECIAL INSPECTIONS

PROJECT: COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001
LOCATION: COLLEGE OF COASTAL GEORGIA, BRUNSWICK, GA
PERMIT APPLICANT: BOARD OF REGENTS OF THE UNIVERSITY SYSTEM OF GEORGIA
APPLICANT'S ADDRESS: 270 WASHINGTON STREET SW, ATLANTA, GA 30334
ARCHITECT OF RECORD: HUSSEY GAY BELL
STRUCTURAL ENGINEER OF RECORD: HUSSEY GAY BELL
MECHANICAL ENGINEER OF RECORD: DULOHERY WEEKS
ELECTRICAL ENGINEER OF RECORD: DULOHERY WEEKS
REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: ROBERT ARMSTRONG, AIA

This Statement of Special Inspections is submitted in accordance with Section 1704.3 of the 2018 International Building Code. It includes a *Schedule of Special Inspection Services* applicable to the above-referenced Project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections. If applicable, it includes *Special Inspections for Seismic Resistance* and/or *Special Inspections for Wind Resistance*.

Are *Special Inspections for Seismic Resistance* included in the *Statement of Special Inspections*? Yes No
 Are *Special Inspections for Wind Resistance* included in the *Statement of Special Inspections*? Yes No

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the Building Official and to the Registered Design Professional in Responsible Charge at a frequency agreed upon by the Design Professional and the Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and corrections of any discrepancies noted in the inspections shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge at the conclusion of the project.

Frequency of interim report submittals to the Registered Design Professional in Responsible Charge:

Weekly Bi-Weekly Monthly Other; specify: _____

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Statement of Special Inspections Prepared by:

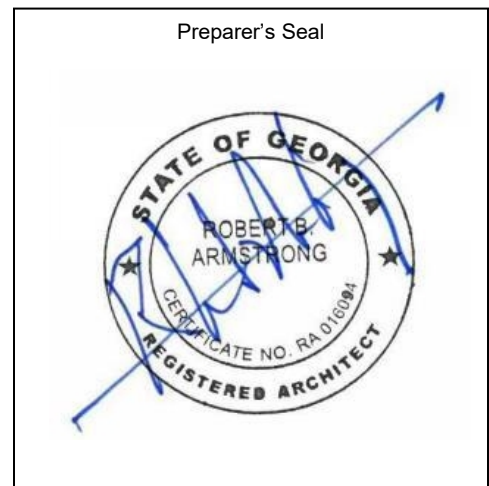
ROBERT ARMSTRONG, AIA
 Type or print name
Robert Armstrong, AIA 2-21-2024
 Signature Date

Building Official's Acceptance:

 Signature Date
 Permit Number:

Frequency of interim report submittals to the Building Official:

Monthly Bi- Monthly Upon Completion Other; specify: _____



Special Inspections for Seismic Resistance

See the Schedule of Special Inspections for inspection and testing requirements

Seismic Design Category: B

Special Inspections for Seismic Resistance Required (Yes/No): NO

Description of seismic force-resisting system subject to special inspection and testing for seismic resistance:

(Where required per IBC Sections 1705.12.1, 1705.12.2, and 1705.12.3) (Special inspections for seismic resistance of structural steel, where required, shall be in accordance with AISC 341)

N/A

Description of designated seismic systems subject to special inspection and testing for seismic resistance:

(Required for architectural, electrical and mechanical systems and their components that require design in accordance with Chapter 13 of ASCE 7, have a component importance factor, I_p , greater than one and are in Seismic Design Categories C, D, E or F.)

N/A

Description of additional seismic systems and components requiring special inspections:

(Required for systems noted in IBC Section 1705.12.5, 1705.12.6, 1705.12.7, and 1705.12.8.)

N/A

Description of additional seismic systems and components requiring testing:

(Where required per IBC Section 1705.13)

N/A

Statement of Responsibility:

Each contractor responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility.

Special Inspections for Wind Resistance

See the Schedule of Special Inspections for inspection and testing requirements

Allowable Stress Design Wind Speed, V_{asd} : 109m.p.h.

Wind Exposure Category: C

Special Inspection for Wind Resistance Required (Yes/No): NO

(Required in wind exposure Category B, where the allowable stress design wind speed, V_{asd} , is 120 miles per hour or greater. Required in wind exposure Category C or D, where the allowable stress design wind speed, V_{asd} , is 110 miles per hour or greater.)

N/A

Description of structural wood and cold-formed steel light frame construction main windforce-resisting system subject to special inspections for wind resistance:

(Required for systems noted in IBC Section 1705.11.1 and 1705.11.2).

N/A

Description of windforce-resisting components subject to special inspections for wind resistance:

(Required for systems and components noted in IBC Section 1705.11.3)

N/A

Statement of Responsibility:

Each contractor responsible for the construction or fabrication of a system or component described above must submit a Statement of Responsibility.

FINAL REPORT OF SPECIAL INSPECTIONS

PROJECT: COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA BR-82-2001
LOCATION: COLLEGE OF COASTAL GEORGIA, BRUNSWICK, GA
PERMIT APPLICANT: BOARD OF REGENTS OF THE UNIVERSITY SYSTEM OF GEORGIA
APPLICANT'S ADDRESS: 270 WASHINGTON STREET SW
ATLANTA, GA 30334
ARCHITECT OF RECORD: HUSSEY GAY BELL
STRUCTURAL ENGINEER OF RECORD: HUSSEY GAY BELL
MECHANICAL ENGINEER OF RECORD: DULOHERY WEEKS
ELECTRICAL ENGINEER OF RECORD: DULOHERY WEEKS
REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE: ROBERT ARMSTRONG, AIA

To the best of my information, knowledge, and belief, which are based upon observations or diligent supervision of our inspection services for the above-referenced Project, I hereby state that the special inspections or testing required for this Project, and designated for this Agent in the *Schedule of Special Inspection Services*, have been completed in accordance with the Contract Documents.

The Special Inspection program does not relieve the Contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Interim reports submitted prior to this final report and numbered ___ to ___ form a basis for, and are to be considered an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated _____ have been corrected:

(Attach 8 1/2"x11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

Special Inspection Agent/Firm

Type or print name

Signature

Date

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.1.1 Special Cases (work unusual in nature, including but not limited to alternative materials and systems, unusual design applications, materials and systems with special manufacturer's requirements - add additional rows as needed.)	Submittal review, shop (3) and/or field inspection				
1. Inspection of anchors post-installed in solid grouted masonry: Per research reports including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, masonry unit, grout, masonry compressive strength, anchor embedment and tightening torque	Field inspection	N	Periodic or as required by the research report issued by an approved source		
2. Aggregate Pier Inspection: The special inspector's responsibilities include, but are not limited to, review of the aggregate pier designer's use of soil parameters as presented in the project soils report, and during construction, verification of aggregate properties, type and number of lifts of aggregate, hole size and depths and top elevations of the pier elements, and applied energy. Additionally, results of qualitative tests on production aggregate pier elements such as modulus load testing, uplift pull-out testing, bottom stabilization tests and dynamic cone penetration tests, shall be reviewed to verify compliance with design specifications.	Field inspection	N	Periodic or as required by the research report issued by an approved source		
1705.2.1 Structural Steel Construction					
1. Fabricator and erector documents (Verify reports and certificates as listed in AISC 360, Section N 3.2 for compliance with construction documents)	Submittal Review	Y	Each submittal	1	
2. Material verification of structural steel	Shop (3) and field inspection	Y	Periodic	1	
3. Structural steel welding:					
a. Inspection tasks Prior to Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-1)	Shop (3) and field inspection	Y	Observe or Perform as noted (4)	1	
b. Inspection tasks During Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-2)	Shop (3) and field inspection	Y	Observe (4)	1	
c. Inspection tasks After Welding (Observe, or perform for each welded joint or member, the QA tasks listed in AISC 360, Table N5.4-3)	Shop (3) and field inspection	Y	Observe or Perform as noted (4)	1	
d. Nondestructive testing (NDT) of welded joints: <i>see Commentary</i>					
1) Complete penetration groove welds 5/16" or greater in <i>risk category</i> III or IV	Shop (3) or field ultrasonic testing - 100%	N	Periodic		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
2) Complete penetration groove welds 5/16" or greater in <i>risk category II</i>	Shop (3) or field ultrasonic testing - 10% of welds minimum	Y	Periodic	1	
3) Welded joints subject to fatigue when required by AISC 360, Appendix 3, Table A-3.1	Shop (3) or field radiographic or Ultrasonic testing	N	Periodic		
4) Fabricator's NDT reports when fabricator performs NDT	Verify reports	Y	Each submittal (5)	1	
4. Structural steel bolting:	Shop (3) and field inspection				
a. Inspection tasks Prior to Bolting (Observe, or perform tasks for each bolted connection, in accordance with QA tasks listed in AISC 360, Table N5.6-1)		Y	Observe or Perform as noted (4)	1	
b. Inspection tasks During Bolting (Observe the QA tasks listed in AISC 360, Table N5.6-2)		Y	Observe (4)	1	
1) Pre-tensioned and slip-critical joints					
a) Turn-of-nut with matching markings		Y	Periodic	1	
b) Direct tension indicator		Y	Periodic	1	
c) Twist-off type tension control bolt		Y	Periodic	1	
d) Turn-of-nut without matching markings		Y	Continuous	1	
e) Calibrated wrench			Continuous		
2) Snug-tight joints		Y	Periodic	1	
c. Inspection tasks After Bolting (Perform tasks for each bolted connection in accordance with QA tasks listed in AISC 360, Table N5.6-3)		Y	Perform (4)	1	
5. Visual inspection of exposed cut surfaces of galvanized structural steel main members and exposed corners of the rectangular HSS for cracks subsequent to galvanizing	Shop (3) or field inspection	N	Periodic		
6. Embedments (Verify diameter, grade, type, length, embedment. See 1705.3 for anchors)	Field inspection	Y	Periodic	1	
7. Verify member locations, braces, stiffeners, and application of joint details at each connection comply with construction documents	Field inspection	Y	Periodic	1	
1705.2.2 Cold-Formed Steel Deck					
1. Manufacturer documents (Verify reports and certificates as listed in SDI QA/QC, Section 2, Paragraphs 2.1 and 2.2 for compliance with construction documents)	Submittal Review	Y	Each submittal	1	
2. Material verification of steel deck, mechanical fasteners and welding materials	Shop (3) and field inspection	Y	Periodic	1	
3. Cold-formed steel deck placement:	Shop (3) and field inspection				
a. Inspection tasks Prior to Deck Placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.1)		Y	Perform (4)	1	
b. Inspection tasks After Deck Placement (Perform the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.2)		Y	Perform (4)	1	
4. Cold-formed steel deck welding:	Shop (3) and field inspection				
a. Inspection tasks Prior to Welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.3)		Y	Observe (4)	1	

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
b. Inspection tasks During Welding (Observe the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.4)		Y	Observe (4)	1	
c. Inspection tasks After Welding (Perform the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.5)		Y	Perform (4)	1	
5. Cold-formed steel deck mechanical fastening:	Shop (3) and field inspection				
a. Inspection tasks Prior to Mechanical Fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.6)		Y	Observe (4)	1	
b. Inspection tasks During Mechanical Fastening (Observe the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.7)		Y	Observe (4)	1	
c. Inspection tasks After Mechanical Fastening (Perform the QA tasks listed in SDI QA/QC, Appendix 1 Table 1.8)		Y	Perform (4)	1	
1705.2.3. Open-Web Steel Joists and Joist Girders					
1. Installation of open-web steel joists and joist girders.					
a. End connections - welding or bolted.	per SJI CJ or SJI 100	Y	Periodic	1	
b.. Bridging - horizontal or diagonal.					
1) Standard bridging.	per SJI CJ or SJI 100	Y	Periodic	1	
2) Bridging that differs from the specifications listed in SJI CJ or SJI 100.		Y	Periodic	1	
1705.2.4. Cold-Formed Steel Trusses Spanning 60 feet or Greater					
Verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package	Field inspection	N	Periodic		
1705.3 Concrete Construction					
1. Inspection and placement verification of reinforcing steel and prestressing tendons.	Shop (3) and field inspection	Y	Periodic	1	
2. Reinforcing bar welding:		N			
a. Verification of weldability of bars other than ASTM A706.			Periodic		
b. Inspection of single-pass fillet welds 5/16 or less in size.			Periodic		
c. Inspection of all other welds.			Continuous		
3. Inspection of anchors cast in concrete.	Shop (3) and field inspection	Y	Periodic	1	
4. Inspection of anchors post-installed in hardened concrete members per research reports, or, if no specific requirements are provided, requirements shall be provided by the registered design professional and approved by the building official, including verification of anchor type, anchor dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete minimum thickness, anchor embedment and tightening torque	Field inspection	Y	Periodic or as required by the research report issued by an approved source	1	
a. Adhesive anchors installed in horizontal or upward-inclined orientation that resist sustained tension loads.		Y	Continuous	1	
b. Mechanical and adhesive anchors note defined in 4a.		N	Periodic		
5. Verify use of approved design mix	Shop (3) and field inspection	Y	Periodic	1	

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
6. Prior to placement, fresh concrete sampling, perform slump and air content tests and determine temperature of concrete and perform any other tests as specified in construction documents.	Shop (3) and field inspection	Y	Continuous	1	
7. Inspection of concrete and shotcrete placement for proper application techniques	Shop (3) and field inspection	Y	Continuous	1	
8. Verify maintenance of specified curing temperature and techniques	Shop (3) and field inspection	Y	Periodic	1	
9. Inspection of prestressed concrete:	Shop (3) and field inspection	N			
a. Application of prestressing force			Continuous		
b. Grouting of bonded prestressing tendons			Continuous		
10. Inspect erection of precast concrete members		Y	Periodic	1	
11. Verification of in-situ concrete strength, prior to stressing of tendons in post tensioned concrete and prior to removal of shores and forms from beams and structural slabs	Review field testing and laboratory reports	N	Periodic		
12. Inspection of formwork for shape, lines, location and dimensions	Field inspection	Y	Periodic	1	
13. Concrete strength testing and verification of compliance with construction documents	Field testing and review of laboratory reports	Y	Periodic	1	
1705.4 Masonry Construction					
MINIMUM VERIFICATION REQUIREMENTS					
(A) Level 1, 2 and 3 Quality Assurance:					
1. Prior to construction, verification of compliance of submittals	Submittal Review	N	Prior to Construction		
(B) Level 2 & 3 Quality Assurance:					
1. Prior to construction verification of f_m and f_{AAC} except where specifically required by the code	Testing by unit strength method or prism test method	N	Prior to Construction		
2. During construction, verification of Slump Flow and Visual Stability Index (VSI) when self-consolidating grout is delivered to project site.	Testing by unit strength method or prism test method	N	Periodic		
(C) Level 3 Quality Assurance:					
1. During construction, verification of f_m and f_{AAC} for every 5,000 SF	Testing by unit strength method or prism test method	N	Periodic		
2. During construction, verification of proportions of materials as delivered to the project site for premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout.	Field inspection	N	Periodic		
MINIMUM SPECIAL INSPECTION REQUIREMENTS					
(D) Levels 2 and 3 Quality Assurance:					
1. As masonry construction begins, verify that the following are in					
a. Proportions of the site-prepared mortar	Field inspection	N	Periodic		
b. Grade and size of prestressing tendons and anchorages	Field Inspection	N	Periodic		
c. Grade, type, and size of reinforcement, anchor bolts, and prestressing tendons and anchorages	Field Inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
d. Prestressing technique	Field Inspection	N	Periodic		
e. Properties of thin-bed mortar for AAC masonry	Field Inspection	N	Level 2 - Continuous ^(b) Level 2 - Periodic ^(c)		
(b) Required for the first 5,000 square feet (c) Required after the first 5,000 square feet		N	Level 3 - Continuous		
f. Sample panel construction	Field Inspection	N	Level 2 - Periodic		
		N	Level 3 - Continuous		
2. Prior to grouting, verify that the following are in compliance:					
a. Grout space	Field Inspection	N	Level 2 - Periodic		
		N	Level 3 - Continuous		
b. Placement of prestressing tendons and anchorages	Field Inspection	N	Periodic		
c. Placement of reinforcement, connectors, and anchor bolts	Field inspection	N	Level 2 - Periodic		
		N	Level 3 - Continuous		
d. Proportions of site-prepared grout and prestressing grout for bonded tendons	Field Inspection	N	Periodic		
3. Verify compliance of the following during construction:					
a. Materials and procedures with the approved submittals	Field inspection	N	Periodic		
b. Placement of masonry units and mortar joint construction	Field Inspection	N	Periodic		
c. Size and location of structural members	Field inspection	N	Periodic		
d. Type, size, location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction	Field inspection	N	Level 2 - Periodic		
		N	Level 3 - Continuous		
e. Welding of reinforcement	Field inspection	N	Continuous		
f. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F)	Field inspection	N	Periodic		
		N	Periodic		
g. Application and measurement of prestressing force	Field testing	N	Continuous		
h. Placement of grout and prestressing grout for bonded tendons is in compliance	Field inspection	N	Continuous		
i. Placement of AAC masonry units and construction of thin-bed mortar joints	Field inspection	N	Level 2 - Continuous ^(b) Level 2 - Periodic ^(c)		
(b) Required for the first 5,000 square feet (c) Required after the first 5,000 square feet		N	Level 3 - Continuous		
4. Observe preparation of grout specimens, mortar specimens, and/or prisms	Field inspection	N	Level 2 - Periodic		
		N	Level 3 - Continuous		
1705.5 Wood Construction					
1. For prefabricated wood structural elements, inspection of the fabrication process and assemblies in accordance with Section 1704.2.5.	In-plant review (3)	N	Periodic		
2. For high-load diaphragms, verify grade and thickness of structural panel sheathing agree with approved building plans.	Field inspection	N	Periodic		
3. For high-load diaphragms, verify nominal size of framing members at adjoining panel edges, nail or staple diameter and length, number of fastener lines, and that spacing between fasteners in each line and at edge margins agree with approved building plans	Field inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
4. Metal-plate-connected wood trusses:		N			
a. Verification that permanent individual truss member restraint/bracing has been installed in accordance with the approved truss submittal package when the truss height is greater than or equal to 60".	Field inspection	N	Periodic		
b. For trusses spanning 60 feet or greater: verify temporary and permanent restraint/bracing are installed in accordance with the approved truss submittal package	Field inspection	N	Periodic		
1705.6 Soils					
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Field inspection	Y	Periodic	1	
2. Verify excavations are extended to proper depth and have reached proper material.	Field inspection	Y	Periodic	1	
3. Perform classification and testing of compacted fill materials.	Field inspection	Y	Periodic	1	
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill	Field inspection	Y	Continuous	1	
5. Prior to placement of controlled fill, inspect subgrade and verify that site has been prepared properly	Field inspection	Y	Periodic	1	
1705.7 Driven Deep Foundations					
1. Verify element materials, sizes and lengths comply with requirements	Field inspection	Y	Continuous	1	
2. Determine capacities of test elements and conduct additional load tests, as required	Field inspection	Y	Continuous	1	
3. Inspect driving operations and maintain complete and accurate records for each element	Field inspection	Y	Continuous	1	
4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element	Field inspection	Y	Continuous	1	
5. For steel elements, perform additional inspections per Section 1705.2	See Section 1705.2	N	See Section 1705.2		
6. For concrete elements and concrete-filled elements, perform tests and additional inspections per Section 1705.3	See Section 1705.3	Y	See Section 1705.3	1	
7. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge	Field inspection	N	In accordance with construction documents		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.8 Cast-in-Place Deep Foundations					
1. Inspect drilling operations and maintain complete and accurate records for each element	Field inspection	N	Continuous		
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	Field inspection	N	Continuous		
3. For concrete elements, perform tests and additional inspections in accordance with Section 1705.3	See Section 1705.3	N	See Section 1705.3		
1705.9 Helical Pile Foundations					
Verify installation equipment, pile dimensions, tip elevations, final depth, final installation torque and other installation data as required by construction documents.	Field inspection	N	Continuous		
1705.10 Fabricated items					
1. List of fabricated items requiring special inspection during fabrication:	Shop inspection	N	As noted in each applicable shop activity		
2. List of fabricated items to be fabricated on the premises of a fabricator approved to perform such work without special inspection (including name of approved agency providing periodic auditing):		N			
1705.11.1 Structural Wood Special Inspections For Wind Resistance					
1. Inspection of field gluing operations of elements of the main windforce-resisting system	Field inspection	N	Continuous		
2. Inspection of nailing, bolting, anchoring and other fastening of components within the main windforce-resisting system, including wood shear walls, wood diaphragms, drag struts, braces and hold-downs.	Shop (3) and field inspection	N	Periodic		
1705.11.2 Cold-formed Steel Special Inspections For Wind Resistance					
1. Inspection during welding operations of elements of the main windforce-resisting system	Shop (3) and field inspection	N	Periodic		
2. Inspection of screw attachment, bolting, anchoring and other fastening of components within the main windforce-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs.	Shop (3) and field inspection	N	Periodic		
1705.11.3 Wind-resisting Components					
1. Roof covering, roof deck and roof framing connections.	Shop (3) and field inspection	N	Periodic		
2. Exterior wall covering and wall connections to roof and floor diaphragms.	Shop (3) and field inspection	N	Periodic		
1705.12.1 Structural Steel Special Inspections for Seismic Resistance					
1. Seismic force-resisting systems in SDC B, C, D, E, or F.	Shop (3) and field inspection	N	In accordance with AISC 341		
2. Structural steel elements in SDC B, C, D, E, or F other than those in Item 1. including struts, collectors, chords and foundation elements.	Shop (3) and field inspection	N	In accordance with AISC 341		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.12.2 Structural Wood Special Inspections for Seismic Resistance					
1. Field gluing operations of elements of the seismic-force resisting system for SDC C, D, E or F.	Field inspection	N	Continuous		
2. Nailing, bolting, anchoring and other fastening of components within the seismic-force-resisting system including wood shear walls, wood diaphragms, drag struts, shear panels and hold-downs for SDC C, D, E or F.	Shop (3) and field inspection	N	Periodic		
1705.12.3 Cold-formed Steel Light-Frame Construction Special Inspections for Seismic Resistance					
1. During welding operations of elements of the seismic-force-resisting system for SDC C, D, E or F.	Shop (3) and field inspection	N	Periodic		
2. Screw attachment, bolting, anchoring and other fastening of components within the seismic-force-resisting system including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs for SDC C, D, E or F.	Shop (3) and field inspection	N	Periodic		
1705.12.4 Designated Seismic Systems Verification Special Inspections for Seismic Resistance					
For SDC C, D, E or F, inspect and verify that that the component label, anchorage or mounting conforms to the certificate of compliance in accordance with ASCE 7 Section 13.2.2.	Field inspection	N	Periodic		
1705.12.5 Architectural Components Special Inspections for Seismic Resistance					
1. For SDC D, E or F, inspection during the erection and fastening of exterior cladding and interior or exterior veneer more than 30 feet above grade or walking surface and weighing more than 5 psf.	Field inspection	N	Periodic		
2. For SDC D, E or F, inspection during the erection and fastening of interior nonbearing walls more than 30 feet above grade or walking surface and weighing more than 15 psf.	Field inspection	N	Periodic		
3. For SDC D, E or F, inspection during the erection and fastening of exterior nonbearing walls more than 30 feet above grade or walking surface.		N			
4. For SDC D, E or F, inspection during anchorage of access floors	Field inspection	N	Periodic		
1705.12.6 Plumbing, Mechanical and Electrical Components Special Inspections for Seismic Resistance					
1. Inspection during the anchorage of electrical equipment for emergency or standby power systems in SDC C, D, E or F	Field inspection	N	Periodic		
2. Inspection during the anchorage of other electrical equipment in SDC E or F	Field inspection	N	Periodic		
3. Inspection during installation and anchorage of piping systems designed to carry hazardous materials, and their associated mechanical units in SDC C, D, E or F	Field inspection	N	Periodic		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT	COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001				
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
4. Inspection during the installation and anchorage of HVAC ductwork designed to contain hazardous materials in SDC C, D, E or F	Field inspection	N	Periodic		
5. Inspection during the installation and anchorage of vibration isolation systems in SDC C, D, E or F where nominal clearance of 1/4 inch or less is required by the approved construction documents	Field inspection	N	Periodic		
6. Inspection during installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed in structures assigned to SDC C, D, E, or F to verify one of the following unless flexible sprinkler hose fittings are used:		N			
a. ASCE/SEI 7, Section 13.2.3 minimum required clearances have been provided.	Field inspection	N	Periodic		
b. A three inch or greater nominal clearance has been provided between fire protection sprinkler system drops and sprigs and: structural members not used collectively or independently to support the sprinklers; equipment attached to the building structure; and other systems' piping.	Field inspection	N	Periodic		
1705.12.7 Storage Racks Special Inspections for Seismic Resistance					
Inspection during the anchorage of storage racks 8 feet or greater in height in structures assigned to SDC D, E or F.	Field inspection	N	Periodic		
1705.12.8 Seismic Isolation Systems					
Inspection during the fabrication and installation of isolator units and energy dissipation devices used as part of the seismic isolation system in structures assigned to SDC B, C, D, E or F.	Shop and field inspection	N	Periodic		
1705.12.9 Cold-formed Steel Special Bolted Moment Frames					
Inspection of installation of cold-formed steel special bolted moment frames in the seismic force-resisting systems in structures assigned to SDC D, E or F.	Field inspection	N	Periodic		
1705.13.1 Structural Steel Testing for Seismic Resistance					
1. Nondestructive testing of structural steel in the seismic force-resisting systems in accordance with AISC 341 in structures assigned to SDC B, C, D, E or F.	Field test	N	Periodic		
2. Nondestructive testing of structural steel elements in the seismic force-resisting systems not covered in 1 above including struts, collectors, chords and foundation elements in accordance with AISC 341 in structures assigned to SDC B, C, D, E or F.	Field test	N	Periodic		

SCHEDULE OF SPECIAL INSPECTIONS SERVICES					
PROJECT		COASTAL COMMUNITY CENTER FOR THE ARTS, COLLEGE OF COASTAL GEORGIA, BR-82-2001			
MATERIAL / ACTIVITY	SERVICE	APPLICABLE TO THIS PROJECT			
		Y/N	EXTENT	AGENT*	DATE COMPLETED
1705.13.2 Seismic Certification of Nonstructural Components					
Review certificate of compliance for designated seismic system components in structures assigned to SDC B, C, D, E or F.	Certificate of compliance review	N	Each submittal		
1705.13.3 Seismic Certification of Designated Seismic Systems					
Review certificate of compliance for designated seismic system components in structures assigned to SDC C, D, E or F	Certificate of compliance review	N	Each submittal		
1705.13.4 Seismic Isolation Systems					
Test seismic isolation system in accordance with ASCE 7 Section 17.8 in structures assigned to SDC B, C, D, E or F.	Prototype testing	N	Per ASCE 7		
1705.14 Sprayed Fire-resistant Materials					
1. Verify surface condition preparation of structural members	Field inspection	N	Periodic		
2. Verify minimum thickness of sprayed fire-resistant materials applied to structural members	Field inspection	N	Periodic		
3. Verify density of the sprayed fire-resistant material complies with approved fire-resistant design	Field inspection and testing	N	Per IBC Section 1705.14.5		
4. Verify the cohesive/adhesive bond strength of the cured sprayed fire-resistant material	Field inspection and testing	N	Per IBC Section 1705.14.6		
5. Condition of finished application	Field inspection	N	Periodic		
1705.15 Mastic and Intumescent Fire-Resistant Coatings					
Inspect and test mastic and intumescent fire-resistant coatings applied to structural elements and decks per AWCI 12-B	Field inspection and testing	N	Periodic		
1705.16 Exterior Insulation and Finish Systems (EIFS)					
Inspection of water-resistive barrier over sheathing substrate	Field inspection	Y	Periodic	1	
1705.17 Fire-Resistant Penetrations and Joints					
1. Inspect penetration firestop systems	Field testing	Y	Per ASTM E2174	1	
2. Inspect fire-resistant joint systems	Field testing	Y	Per ASTM E2393	1	
1705.18 Smoke Control Systems					
1. Leakage testing and recording of device locations prior to concealment	Field testing	N	Periodic		
2. Prior to occupancy and after sufficient completion, pressure difference testing, flow measurements, and detection and control verification	Field testing	N	Periodic		
* INSPECTION AGENTS					
FIRM	ADDRESS		TELEPHONE NO.		
1. TO BE DETERMINED					
2.					
3.					
4.					
<p>Notes: 1. The inspection and testing agent(s) shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official prior to commencing work. The qualifications of the Special Inspector(s) and/or testing agencies may be subject to the approval of the Building Official and/or the Design Professional.</p> <p>2. The list of Special Inspectors may be submitted as a separate document, if noted so above.</p> <p>3. Shop Inspections of fabricated items are not required where the fabricator is approved in accordance with IBC Section 1704.2.5.1 and listed in activity 1709.2.</p> <p>4. Observe: Observe on a random basis, operations need not be delayed pending these inspections. Perform: These tasks shall be performed for each welded joint, bolted connection, or steel element.</p> <p>5. NDT of welds completed in an approved fabricator's shop may be performed by that fabricator when approved by the AHJ. Refer to AISC 360, N6.</p>					
Are Special Inspections for Seismic Resistance included in the Statement of Special Inspections?				Yes	No
Are Special Inspections for Wind Resistance included in the Statement of Special Inspections?				Yes	No
DATE:				2/21/2024	